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Lahey Clinic Number

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COMMON DUCT STONE

FRANK H. LAHEY

Case I.—Three months before entrance to the hospital Mrs. A. C., a woman of forty-eight, was suddenly seized with severe, knife-like pain in the right upper quadrant with radiation of the pain to the intrascapular region. She vomited a number of times after the onset of the pain. Five days later her skin and scleræ were yellow. The jaundice had persisted and had increased in intensity. The pain recurred at intervals. She was markedly jaundiced. The quantitative van den Bergh test showed a bilirubin of 14.4. There was a strong direct reaction. There was tenderness in the right upper quadrant extending somewhat beyond the midline to the left. The gall-bladder was not palpable. The temperature at entrance was 104° F. Coagulation time was thirty minutes. The urine showed granular casts. Her nonprotein nitrogen was 50. In view of the intense jaundice, operation was delayed until the coagulation time had reached normal limits and considerable amounts of fluid and glucose had been administered. After four days the coagulation time had been reduced to eighteen minutes (still too high), but the patient's general condition had improved, her temperature had dropped to 99° F., and her general appearance was much better. Operation was done.

Upper right rectus muscle-splitting incision. The liver extended for several fingers' breadth below the costal margin. Gall-bladder dilated to twice its normal size, and was seen to be covered with omentum upon opening the peritoneal cavity.

Omental adhesions carefully separated. Gall-bladder was found to have a very much thickened wall, obviously the seat of inflammatory process, and very intimately adherent to the bed of the liver. The region of the ducts was markedly obscured by a thick layer of bile-stained exudate. In view of the distortion of the anatomy of the ducts and the extremely adherent, friable condition of the gall-bladder wall, it was decided to remove the gall-bladder from above downward. A line of cleavage was secured and the gall-bladder freed from its bed. There was considerable oozing which was controlled by inserting a gauze pack in the liver fossa. After considerable difficulty the common duct was identified and a stone felt just above the entrance of the common duct into the duodenum. After dissection through the layer of exudate the relations became clear. The duodenum was then carefully mobilized and retracted inward and downward. The stone could now be readily palpated. A linear incision was made over the stone and the stone—the size of a small olive—was removed. There was a small amount of detritus. A probe now passed readily into the duodenum and also upward into the the hepatic duct. T-tube inserted to the common duct and the edges approximated around it. Wound closed in layers around a T-tube drain.

The pathologic report was returned, "Acute and chronic cholecystitis; bile stasis of the liver; acute inflammatory reaction of the liver; chronic periportal inflammation; chronic cholangitis." A small section of liver tissue was submitted to the pathologist together with the gall-bladder.

The patient made an excellent recovery and was discharged three weeks following operation. Her stools were bile colored and the jaundice had practically disappeared.

Case II.—Mrs. M. E. H., a woman of forty-nine, complained of frequent sick headache with nausea and vomiting. She had had several attacks each year for several years. With the subsidence of each attack there was tenderness just below the right costal margin. Between attacks she was bothered considerably by "gas" and had a fairly constant sense of epigastric pressure

after eating. When she entered the clinic she was just recovering from one of her attacks. There was definite tenderness over the gall-bladder. The cholecystogram suggested the possibility of negative shadows in the gall-bladder area. The bilirubin was 0.4, the non-protein nitrogen 34. Operation was performed.

Right rectus incision. A pale gall-bladder with markedly thickened walls found deeply embedded in the liver. This was removed from below upward; the cystic artery carefully ligated as a trunk and demonstrated as separate from the hepatic artery. The cystic duct found parallel to the hepatic duct. It was freed, cut, and ligated. Common duct normal in size; not thickened; blue, and showed no indication of stones. Three stone-like masses, however, were palpated behind the duodenum at the point where the common duct enters the duodenum. Because of the small caliber of the portion of the common duct which was not retroduodenal the stones could not be removed through it. The parietal peritoneum over the duodenum was therefore freed. The duodenum was inverted and the common duct dissected down on the posterior wall of the duodenum. An incision was made in the duct about ½ inch from its entrance in the duodenum. Three large stones were removed; a fourth stone the size of a shoe-button at the ampulla was pushed into the duodenum. The duct was carefully palpated for further stones, but none were found. A catheter passed readily into the duodenum and fluid passed into the duodenum and did not return around the catheter. A T-tube was sutured in the common duct. The hepatic duct was carefully explored for stones and none were found.

The patient made an excellent recovery and left the hospital in good condition.

Case III.—A woman of thirty-four had had a cholecystectomy six years before for cholelithiasis. There were stones in the common duct at that time and a choledochostomy was done as well. She made a good recovery from that operation and had considered herself well until about ten weeks before coming to the clinic, when she had had an operation for a left antrum infection. She made a poor recovery from this operation. About ten days after

the antrum she had a severe chill and was prostrated. A chill the following day was attended by severe pain in the upper abdomen radiating to the back and to the chest. Her temperature rose and persisted together with the pain for fourteen days. She became jaundiced, her stools were acholic. She lost 35 pounds in weight in three weeks. During the month before she entered the clinic she slowly regained her strength and had gained 15 pounds in weight.

At the time of her entrance to the clinic there was slight jaundice. There was a moderate degree of tenderness in the right upper quadrant. Bilirubin was 1. In our opinion there was possibly a persisting stone in the common duct together with a certain amount of cholangitis. Operation was decided upon.

Operation.—A high right rectus muscle-splitting incision. The hepatic flexure was found adherent to the wound. Pylorus and duodenum were also attached to the inner surface of the liver. All adhesions were carefully separated and the common duct exposed. The duct was found to be about $\frac{3}{4}$ inch in diameter. It was incised, with the escape of a large quantity of mucopurulent material. A probe was passed readily down into the duodenum and catheter passed down to the duodenum. Water injected through the catheter passed readily into the duodenum and was not returned. The little finger could be passed through a patent sphincter of Oddi. After thorough irrigation of the common duct a T-tube was inserted and the edges of the choledochostomy incision closed about it. Cigarette drain placed to the foramen of Winslow. Wound closed in layers to T-tube and drain.

Patient's operative recovery was uneventful and she made a very satisfactory convalescence. She was discharged with the T-tube in place. This was removed after about three weeks. The wound then closed and she has been without trouble since.

From the above cases it is evident that it is quite impossible to state that there is any typical history which characterizes the presence of common duct stones as a whole. From these cases it is shown that a history strongly suggestive of common

duct stones may be present, yet no stones be demonstrable in the ducts; and in reverse manner the history may be such as in no way to suggest the presence of common duct stones, yet several stones may be present.

From our experience with this condition we have come to realize that many of the signs which have been stated as indicating the presence of common duct stones are occasionally present without stones, and that any patient with gall-stones may and very frequently does harbor a stone or stones in his common duct with none of these signs. Our experience with this condition, however, has led us to believe that there will be more cases without jaundice, fever or chills, or, for that matter, without any typical symptoms and having stones in their common ducts than there will be cases with typical jaundice, fever, and chills.

In a patient having a typical attack of gall-stone colic, associated with or followed by jaundice, one may well be suspicious, but by no means certain, of the presence of a common duct stone or stones. In a patient with repeated attacks of gall-stone colic, each associated with or followed by jaundice, one may be fairly well convinced of the presence of a common duct stone. In a patient with repeated attacks of gall-stone colic associated with jaundice and fever, as occasionally occurs, one may be quite certain of the presence of common duct stone with infection extending up the ducts. We have, however, seen this later condition, but without the typical biliary colic, in patients several times with only a purulent infection in the common duct and no stones.

The diagnosis of common duct stones is in itself not as important as is the realization that they may exist without symptoms, are frequently unsought for, or not sufficiently sought for, and are the most frequent cause of the attacks of pain which occur after removal of the gall-bladder for stones, without the discovery or removal of stones in the ducts.

We have in past years had certain criteria by which we have determined as to whether or not common duct stones were definitely or probably present and by which to decide for or against

exploration of the ducts. Due to our further experiences with common duct stones within the last few days we have been forced to modify our views until we must admit now that we have again and again found common duct stones, particularly at the ampulla of Vater, in cases in which one could not feel the stones with the abdomen opened, nor could we find any features of the history or state of the ducts which would lead us to suspect their presence.

In our earliest experience with biliary tract surgery we were quite satisfied with palpation of the ducts as a method of determining the presence or absence of duct stones. A little later we felt that exploration of the ducts should only be done when a suggestive history, such as the occurrence of repeated attacks of colic with jaundice, was associated with either positive palpation of stones or a suspicion of their presence. We were further aided in determining to explore the ducts when we could demonstrate thickening and dilatation of the ducts. We are still of the belief that all thickened and certainly all dilated ducts found at the time cholecystectomy is performed for gall-stones should be explored, but we have now come to the position, from our operations, where we feel sure that common duct stones may be present without a shred of history, without being palpable, and without any characteristic evidence in the ducts to indicate their presence. We have removed three stones at the ampulla from a common duct which was entirely normal in caliber (Case II), of the same thin, semitransparent texture as are ducts which have never harbored stones or been the site of infection. This we know to be the exception, but the fact remains that this removes the last support to our conception that when common duct stones have existed within the ducts for any length of time, there will be found dilatation and thickening of the ducts.

We have repeatedly found common duct stones with no history characteristically suggesting their presence, and since we have found them in a common duct, at least the visible and extraduodenal portion of which was undilated and of normal texture, and in a case in which we were unable to palpate them, we must assume that unless we explore many more cases than has been

the custom in the past, we are going to leave behind in gall-stone cases a considerable number of common duct stones.

Our position regarding the demonstration of common duct stones should be, then, that affirmative evidence of the presence of stones is of value and should by all means lead us to rule out the possible presence of common duct stones. Every thickened and dilated common and hepatic duct should be explored, and the decision as to the possible presence of stone in the ducts should not be settled solely by the inability to feel stones by palpation.

Palpation of small stones in the lower part of the duct is by no means easy, and in certain cases is impossible. The fact that a considerable part of the common duct runs behind the duodenum and that in many cases the retroduodenal portion of the duct runs in the head of the pancreas indicates how uncertain and unsatisfactory palpation for stones may be in this region. The difficulty is further added to when we realize the frequency with which induration of the head of the pancreas is associated with gall-stones, and particularly common duct stones lodged at the ampulla of Vater.

While we have stated our experiences in finding common duct stones at the lower end of the ducts without symptoms, and in a case in which a normal appearing duct—both as to size and consistency—was found, we would by no means take the position that in any patient operated for gall-stones the common duct should be explored. This would, we believe, result in many unnecessary explorations and would doubltess raise the mortality somewhat. We have discussed this point in order to stress the fact that common duct stones are much more common than is frequently assumed, that the fact that they cannot be felt does not mean that they are not present, and that many more explorations of the ducts than are usually done should be employed.

Regarding the possibility of common duct stones in a patient with normal appearing duct, we can only say that should examination reveal any suspicious thickening on palpation about the region of the ampulla, regardless of the character of the duct walls, they should be opened and explored.

In all doubtful cases we have been aided in palpating stones in the ducts at the region of the ampulla (palpation elsewhere up to the point where the hepatic ducts enter the liver is quite simple and satisfactory) by cutting the parietal peritoneum where it passes over the duodenum on to the posterior intra-abdominal wall. This permits mobilization of the duodenum, the examining finger may be passed behind it, and with the index-finger behind and the thumb front, the duodenum and its contained duct may be rolled between the fingers, making thus the demonstration of small stones at the ampulla portion of the duct more definite and reliable.

When the duct is to be incised, this procedure is also of value in that it permits the incision to be made into the duct at a point lower than can be made if the retroduodenal portion of the duct is not exposed. The lower the incision in the duct is made, the shorter distance will one have to reach with stone forceps to extract the stones from their position at the entrance of the duct into the duodenum.

When the common duct is opened one should observe carefully what kind of material escapes from it. If there be bile mixed with shreds of detritis, there will rarely fail to be common duct stones. If clear bile escapes, but on reaching down into the duct with common duct forceps shreds of mucus and dark strings of detritus are withdrawn, one may be quite certain that there are common duct stones at the lowest part of the duct. By gently advancing and manipulating the common duct stone forceps the stones may usually be extracted upward through the duct. It has been our experience, however, that no matter how gentle our manipulations may be, we frequently find that we have crushed the stones and that they must be delivered in fragments by forceps and scoops. When fragmentation of the stones has occurred, a small catheter should be inserted down to the ampulla and the lower end of the duct forcibly irrigated, so that there is a return flow of fluid through the incision in the common duct of sufficient force to carry out with it any fragments of the stones which may remain in the ducts.

Occasionally a dilated common duct will be opened in which

no stones will be found. We have several times had the experience of palpating a stone in the common duct and of finding that our manipulations to accomplish its removal have forced it into the duodenum where it could be palpated and leaving the common duct clear. This will doubtless occur spontaneously at times, leaving us at a loss to explain the overdistended duct without obstruction from any apparent cause.

One occasionally finds a thickened and dilated common duct without stones and associated frequently with jaundice and fever. On opening it no stones will be found, but the duct will be two or three times normal size and its lining membrane will show small red petechia-like spots. We have several times seen this type of dilated duct without stones, and believe it to be the result of long-standing infection. We have drained this type of duct for a long time—several weeks—with the purpose in mind of ridding the ducts as completely as possible of infection before the duct drainage is removed.

We have for a long time employed T-tube drainage, passing one end upward into the hepatic duct and the other downward into the common duct. There are a few features regarding the employment of T-tubes which we would like to mention. One is that only tubes of the purest rubber and reinforced at the junction of the transverse with the longitudinal limb should be employed. We have no interest in any special make except that it be strong and made of sufficiently good rubber which will not deteriorate and pull off, when being removed days or weeks postoperatively, at the part where the limbs join, leaving one portion implanted in the ducts and necessitating a secondary operation for its removal. We have found no tubes which approach those made by Eynard of Paris, and have never had any difficulty in their breaking. Each tube should, however, be carefully tested before introducing it.

The tubes as supplied by the dealer have such long transverse limbs that were they inserted as they are received one limb would project above the division of the hepatic duct and the other would pass through the sphincter of Oddi into the duodenum. It is therefore necessary to cut the transverse ends to such

length as to fit the needs in each case. It has always been our custom to cut the transverse limbs of the tubes sufficiently short so that they will pass but a short distance upward and downward beyond the point where the longitudinal incision in the duct has been made. We feel that it is a disadvantage to introduce any more foreign material into the bile passages than is necessary, and all that is necessary is to have enough of the two limbs of the tube above and below the incision in the duct to hold it in place securely after the incision in the duct has been sutured about the tube. Care should be taken particularly with the lower limb of the tube to be certain that it is sufficiently short so that it cannot possibly pass into the duodenum, permitting the return of duodenal contents or interfering perhaps with the outflow of pancreatic juice through mechanical obstruction of the duct of Wirsung. There are very few cases in which either transverse limb of the T-tube needs to be more than 1 inch in length.

Another important factor, we believe, in the introduction of common duct T-tubes, particularly if the duodenum has been mobilized as we have described here, is that the external portion of the tube should be brought out of the common duct at the uppermost part of the incision in the common duct. This, we feel, is of importance, as it thus guards against any possible pressure necrosis in the duodenum, as might arise were the tube sutured so low into the common duct that its longitudinal limb would rest constantly against the external wall of the duodenum.

In common duct cases in which there has been no marked infection it is our custom to remove the tube on the twelfth to the fourteenth day, so that the biliary drainage through the incision may have a chance to diminish and cease before the patient leaves the hospital at the end of three weeks. In those cases in which there has been considerable infection we send the patients home with the T-tube still in place, and frequently do not remove it for eight weeks. Due to the ease with which the tube buckles at the junction of the T, and to the fact that we have cut the ends until they are not more than 1 inch in length, we have never had the slightest difficulty in removing them even at the end of this time.

T-tube drainage is very satisfactory in that it permits of complete closure of the incision in the duct over the ends of the tube up to its longitudinal limb, so that there is little or no leakage of bile about the point where the tube is introduced into the duct. In addition to this it is possible, by clamping the tube for a few hours each day, at the end of four or five days, when the wound in the duct is healed, to cause bile to flow down the tube and be delivered into the duodenum, a feature which we feel sure is of advantage to the patient.

Conclusions.—The history and operative evidences of the presence of common duct stones are not consistently typical.

Mere manual palpation is often not reliable evidence as to the absence of common duct stones. This palpation may, however, be facilitated by mobilization of the duodenum as here described.

The investigation of all common ducts in the least suspected of harboring common duct stones will surprisingly often reveal the presence of common duct stones, most often at the ampulla of Vater.

Infected common ducts should be drained for several weeks.

T-tube drainage is very satisfactory, in that bile may quite constantly be delivered into the intestinal tract during the recovery.

THE MANAGEMENT OF POST-THYROIDECTOMY COMPLICATIONS

FRANK H. LAHEY

WHILE proper preparation and operative management play the greatest part in maintaining a low mortality rate in partial thyroidectomy, postoperative management is also very intimately related to the mortality rate. I hardly know of a surgical procedure which can be followed so suddenly by postoperative complications of such a character that, unless immediately combated by proper measures, in a very considerable number of instances eventuates in a fatal outcome.

Postoperative hemorrhage following partial thyroidectomy, if arterial in character, is a most serious complication, not, as one inexperienced with this calamity would assume, as the result of blood loss, but because of the respiratory obstruction which results from the accumulation of blood in a large quantity beneath the sutured prethyroid muscles, producing such pressure upon the trachea that unless relieved at once, death follows from suffocation.

The two arterial trunks, excepting the thyroidia ima, only occasionally present, which can produce serious thyroid bleeding are, of course, the superior thyroid artery and the inferior thyroid artery. Both are arterial branches which are close to their origin from good-sized main trunks—the superior from the external carotid and the inferior from the thyroid axis.

When hemorrhage from either the superior or inferior thyroid arteries occurs the clot accumulates in the muscle plane beneath the sternohyoid, sternothyroid, omohyoid, and sternocleidomastoid muscles. Since this space is practically a tight pocket and blood continues to flow into it without possibility of escape, the pressure on the trachea eventually becomes what-

ever the blood-pressure is, and evidences itself by greater and greater difficulty in breathing until cyanosis, unconsciousness, and such tracheal obstruction result that were the condition permitted to go on unrelieved, death would doubtless result. It is evident, therefore, that the symptoms of arterial hemorrhage following partial thyroidectomy are not those of blood loss and similar to those of postoperative hemorrhage elsewhere, but those of tracheal pressure.

While marked bulging of the neck does not usually occur due to the fact that the accumulating clot is beneath the prethyroid muscles, still there is a fulness and firmness to the neck which, when associated with alarming respiratory difficulty, makes the diagnosis of this complication by no means difficult.

This extremely critical postoperative complication has occurred in our operative experience with goiter, now numbering five thousand four hundred operations, six times, and due to its early recognition by head nurses, who have become experienced with operated thyroid patients, it has been discovered and cared for in sufficient time so that no fatality has resulted from it.

Since the immediate cause of the difficulty is tracheal pressure and the immediate danger suffocation, the essential measure indicated is the relief of pressure. This may be instantly accomplished by removing the skin clips and cutting the mattress sutures which hold the prethyroid muscles together. This can be done in less than a minute, and there is nothing more dramatic in surgery than the relief which follows. The large clot is no longer restrained in its tight-walled cavity, but bulges forward as soon as the prethyroid muscles are cut, resulting in almost instantaneous respiratory relief. Breathing becomes easy, the color clears as the unconscious or semiconscious patient rouses to consciousness. The wound may be packed with gauze and the patient may then be unhurriedly taken to the operating room, anesthetized, the bleeding vessel deliberately exposed and ligated, and the wound accurately reclosed. We strongly urge that in any operated patient with difficult breathing in whom there is no reason to expect urgent and progressive postoperative respiratory obstruction, the possible occurrence of this

emergency be at once suspected, the wound immediately opened, and the prethyroid muscles separated.

It is unusual for venous bleeding beneath the prethyroid muscles to produce obstructive symptoms of such urgency as those described above because of the relatively low venous pressure, yet we have once or twice seen serious respiratory difficulty when bleeding has occurred from large venous branches close to their origin from the internal jugular vein. Their management is, of course, similar to that described above for arterial hemorrhages.

All postoperative bleeding following thyroid operations, other than that occurring as just described beneath the prethyroid muscles, is entirely venous in character and of a non-serious nature. Oozing may occur from the large veins on the anterior surfaces of the prethyroid muscles, from skin edges or the posterior surface of the skin flap, where it has been elevated from the underlying muscles. This is readily recognized, since it produces very obvious forward bulging of the skin flap, but does not produce the slightest interference with breathing. Removal of the skin clips and elevation of the skin flap, together with removal of the accumulated clot, permits ready demonstration and control of the oozing part.

Deaths on the operating table during the performance of subtotal thyroidectomy are largely a thing of the past. Due to our improved preparation of these cases and our ability to properly estimate the operative risk and adjust our operative procedures to them, this most distressing calamity does not occur. The same fact, however, cannot be said to be true of postoperative thyroid reactions. While we have by the same measures of preparation and selective judgment, as described above, almost eliminated the complication of severe postoperative thyroid reactions or so-called thyroid storms, nevertheless they still do occasionally occur, and they remain in our experience one of the few insurmountable difficulties playing a large part in the mortality of operations for toxic goiter. Preoperative rest, fluids, a high carbohydrate diet, and iodin therapy have completely effaced this disturbing and often fatally terminating

postoperative complication. In spite of these measures, however, it will and does occasionally occur, and when it does we feel that in a great majority of instances it is a reflection upon the keenness of our discrimination and ability to adjust operative procedures to the seriousness of the patient's true toxic state after adequate preparation, and to their ability to withstand them. We feel very strongly that the number of serious reactions occurring after thyroid operations is a quite accurate index as to the refinement of our operative judgment. We have rarely had serious reactions occur, but that by a review of the case we could find sufficient evidence which, when studied again, showed plenty of reason to have suspected preoperatively the possibility of its occurrence, so that we should have better adjusted and limited our operative procedures to meet it. Its appearance in our hands represents a very small group of cases in a large series. Of the group having the reaction, a small part, I believe, cannot be preoperatively suspected and guarded against, but a large part represent the percentage of human error in judgment and failure to study or be impressed with facts which exist and are demonstrable in the past history and course of the case during preparation, but are not appreciated by the observer. We are firmly convinced that no operative procedure should be undertaken on any thyrotoxic patient until all details of the past and preoperative course of the case have been carefully digested just before the operation by anesthetist, assistant, and surgeon operating on the case.

Preoperative preparation, particularly with iodin, has in a large measure eliminated the multiple stage measures of the past concerning which we have written frequently. We wish again to state, however, that in any patient with any markedly unfavorable factors in her immediate history, such as marked loss of weight, a history of recent crisis, such as diarrhea or vomiting, failure to respond to iodin, or showing unexpectedly serious reaction to anesthesia and operative procedures while on the operating table, such as persistently rising pulse rates, approaching a rate of two hundred, or persistently elevated or increasing pulse pressure, should be subjected to some form of a

graded thyroid operation, usually a two-stage subtotal thyroidectomy. This is accomplished by the subtotal removal of one lobe first and of the other one six weeks later. We have a distinct conviction that should a patient die in a thyroid reaction following a complete subtotal thyroidectomy, there is certainly a considerable chance that he or she would not have died had the procedure been limited to the preliminary removal of but a single lobe. We feel that this position is substantiated by the fact that in our entire experience with subtotal thyroidectomy, when divided into two hemithyroidectomies, we have never had a patient die following the second-stage hemithyroidectomy, and so great has the improvement been in the six weeks' interval between the right and left hemithyroidectomy that we have rarely seen even severe reactions following the second-stage procedure.

The clinical features of severe postoperative thyroid reactions are high and rising pulse rate, increasing excitability, activation, and delirium, replaced at times by stupor deepening to unconsciousness, vomiting, and at times unbelievably high temperatures without infection being apparent.

The means at our disposal to combat these symptoms are fluids, glucose, morphin, and iodin. Fluids to meet the needs of increased combustion, likewise glucose for the same purpose, and for the purpose of conserving the glycogen reserve in the liver which is depleted by severe thyroid reactions. Morphin to overcome the marked activation and to lessen effort expenditures which are pyramided upon an already overburdened and top-heavy metabolic activity. When patients in postoperative thyroid reactions are struggling and restlessly threshing about the bed, requiring physical and mechanical restraint, morphin must be employed in doses far beyond the doses used in almost any other condition. One must accept the risk of morphin poisoning as less than the effects of continued overactivation and excitation.

The employment of iodin in postoperative thyroid reaction is far less satisfactory than its employment in preoperative preparation, inasmuch as the operative procedure is not under-

taken until the maximum benefit from iodin therapy has been obtained, and while it is a well-known fact that if iodin is not continued immediately following the operative procedure a very severe reaction will result, it is likewise known that once the iodin improvement has been obtained, the further administration of iodin serves only to maintain this gain through and immediately after the operation, and does not permit of the accomplishment of any more marked and striking improvement. It is evident then that while no outstandingly evident change in the reaction may be accomplished by the employment of iodin, nevertheless its introduction into the system must continue to be accomplished postoperatively, lest an already severe reaction be intensified by its absence. During the stage of reaction iodin may usually be taken by mouth, and if impossible to introduce it in this way, may be given by rectum, 10 drops each time, until 100 drops have been given, or intravenously, 15 grains of sodium iodid, once daily.

Postoperative thyroid reactions, like many other postoperative complications, are largely avoidable, and, to employ a Hibernianism, are best managed by the employment of procedures so planned that they do not occur, or occur only in states of moderate intensity and severity.

We have in previous paragraphs already discussed the question of tracheal obstruction associated with arterial bleeding beneath the sutured prethyroid muscles, so that nothing further need be said on this subject as a cause of respiratory difficulty following partial thyroidectomy.

The most frequent cause of interference with respiration immediately following partial thyroidectomy is tracheitis with the accumulation of quantities of thick, tenacious mucus within the trachea and bronchi, causing labored breathing, limitation of air intake, and a considerable degree of exhaustion from the muscular efforts necessary to accomplish its removal by raising. While it has been repeatedly stated that this reaction is the result of trauma to the trachea consequent to the removal of thyroid tissue from the trachea thus leaving it bare, and can be avoided by leaving attached to the trachea a thin layer of thyroid

tissue which will serve to protect it, we have seen distressing tracheitis occur when good-sized segments of thyroid tissue were left attached to the trachea to accomplish this protection, and have likewise seen it fail to occur when the trachea had been stripped bare of all thyroid tissue, so that at least one-half of the tracheal circumference was bare and unprotected by any adherent thyroid tissue whatever.

When tracheitis has occurred, moisture in the form of steam inhalations is the most successful measure which may be employed for this complication. We have used it in cases of moderate severity in the form of a cup with a cone made from a folded towel attached to it, so that the patient can apply it to her face, taking frequent deep inhalations of the steamy vapor and, in severe cases, by the employment of a tent completely surrounding the patient's head and trunk and filled with steam vapor. We have rarely seen relief fail to be accomplished by these procedures carried on for one to three days following the operation. By the end of this time this troublesome complication has usually disappeared.

Tracheal obstruction due to pressure after the patient has been returned to bed, or while the patient is still on the operating table after the wound has been closed, is by no means an uncommon complication, and one which must be relieved promptly.

It is a fact which has more than once in the past been sadly demonstrated to us, that thyrotoxic patients and, for that matter, non-thyrotoxic patients withstand diminished air intake very badly. There is a very natural tendency on the part of every one to delay further operative procedures, often until the indications that something must be done to improve breathing are so evident that, when tracheotomy or relief of pressure is accomplished, it is too late. The semistuporous patient becomes comatose and death results. It must be a maxim in the operative management of thyroidectomized patients that persisting interference with breathing must be relieved promptly.

The suture of segments of oozing thyroid tissue may result in pressure with the neck returned to its proper position and the chin depressed upon the chest. In the same manner, shortening

of the prethyroid muscles by suture may cause such pressure upon stumps of thyroid tissue as to interfere with breathing, and the suture of the small remaining segment of thyroid tissue to the trachea as we have described in our technic may likewise, with the neck flexed forward on the chest, cause alarming and dangerous obstructive symptoms.

Actual collapse of the trachea as the result of pressure atrophy of the tracheal rings has been rare in our experience. We have seen the trachea so flattened by the anteroposterior or lateral pressure of adenomata that it was almost flatly folded on itself, yet removal of the adenomata causing pressure has almost constantly resulted in immediate improvement in the breathing. We have once had to suture the collapsed trachea on either side by sutures to the sternomastoids to hold it satisfactorily open, but this is the only occasion that we are able to recall where removal of the tumor or tissue causing pressure has not resulted in immediate relief.

We would strongly urge, therefore, that, should any considerable degree of interference with breathing exist following the closure of the wound while the patient is still on the table, anesthesia be continued or resumed, the wound reopened, and the cause for the obstruction be immediately sought for and relieved, so that the patient is returned to bed, breathing freely. We proffer this advice, because we have in the past sent patients back to bed with considerable degrees of respiratory obstruction, only to find it necessary to return them to the operating room, reanesthetize them, reopen their wounds, and relieve the obstruction. It is easier on the patient and a much less serious procedure if it be done as soon as it is observed following wound closure. We urge also that any marked degrees of obstruction be investigated early and, if not immediately and completely relievable by removal of some pressure part, a tracheotomy be done. Tracheotomy is similar to transfusion in the respect that the time to do a tracheotomy is usually when one is debating as to whether or not it should be done, not when its indication is urgent and undoubted.

Injury to one or both recurrent laryngeal nerves may cause

a very urgent postoperative complication by resulting in the vocal cords assuming such a median position corresponding to that of adduction without the opposing effect of abducting, with the result that the glottic space between the cords is so narrow that it does not provide an airway of sufficient size to meet the patient's requirements for oxygen. If, in addition to this, we superimpose a tracheitis on this complication with the accumulation of considerable mucus, there will be an occasional urgent interference with breathing, due to the difficulty in expelling the tenacious mucus through the narrow glottic space, that may become so urgent as to require an immediate tracheotomy.

As a measure of protection to those responsible for the patient's condition during and after operation, in all doubtful cases, or cases having tumors of such character and location that they could produce paralysis of the recurrent laryngeal nerve, preoperative examination of the larynx should be carried out to be certain that a unilateral laryngeal paralysis is not already present before the operation is undertaken.

Any patient showing immediate postoperative difficulty in breathing should have a laryngeal examination of the vocal cords at once, to demonstrate or to rule out the presence of laryngeal paralysis. Should paralysis of one cord be noted, there will be no occasion to undertake further measures, as we have not seen any serious interference with breathing result from unilateral laryngeal paralysis. We have been informed by a colleague that he has seen respiratory obstruction in a patient with a unilateral paralysis of this type. Should bilateral paralysis be noted without urgent symptoms, and should urgent symptoms appear in the days following the operation, it will be appreciated then at once that a tracheotomy must be done without delay. Should a bilateral paralysis be present, but no marked interference with breathing be present, arrangements must be made to follow the course of the paralysis, in order to determine by frequent observations whether or not it is of a temporary nature, as may be shown by demonstrable return of function, or that it is of a permanent nature, as demonstrated by continuation of the pa-

ralysis with no return of function. Should the paralysis persist for three to four months without change and with no evidence of the cords being able to abduct, exploration of the recurrent laryngeal nerve should be undertaken at once to determine the possibility of finding and joining the severed or scarred ends of the nerve. This we have once been successful in doing three months after the patient had been operated for thyroid disease elsewhere, with a return of function and relief of breathing difficulty. We believe that this is an important point, since the sooner suture of the scarred or severed nerve can be undertaken, the more certain will be the return of function.

Unilateral and bilateral injuries to the recurrent laryngeal nerves are similar to postoperative thyroid reactions. They should, in general, be provided against in the original operative procedure. When subtotal thyroidectomy is carefully done, except in those patients with deeply located intrathoracic goiters distorting the course and relations of the recurrent laryngeal nerve, paralysis of this type will not occur. A dry field, a good exposure, deliberate dissection, and the leaving of a strip of thyroid tissue over the region and course of the nerve will insure, in practically every case, protection against the occurrence of paralyses of these types.

The occurrence of postoperative tetany is, as is recurrent laryngeal paralysis, closely related to the scheme, the skill, and the care with which the operation of partial thyroidectomy is done. Every one is familiar with the location of the parathyroids at the region where the branches of the inferior thyroid artery enter the thyroid gland, and on the posterior surface of the upper part of the gland where the tapering upper pole rests against the larynx and trachea. It is true, as we have shown and as has been frequently stated in the literature, that parathyroids may be occasionally found within the substance of the gland and on its anterior instead of its posterior surface, but all four glands or even both inferior glands must rarely, if ever, be all located in unusual and abnormal positions. Care, then, directed toward the preservation of these glands will result in the very rare occurrence of complete and permanent tetany. In our en-

tire series of goiter operations we have seen but 3 cases of complete tetany.

Transient tetany, as evidenced by hyperexcitability of the peripheral nerves shown by galvanic stimulation and by the Chvostek's and Trousseau's signs, or even transient tetanic seizures may occur only to disappear permanently in a few days without treatment. Tetany of this type, even that characterized by temporary low blood-calcium content, is, we believe, in all likelihood due to temporary interference with the blood supply of the remaining parathyroids or parathyroid, with relief of symptoms as soon as the exudate following the operation is absorbed and the interference with the blood-supply to these small glands restored. We have more than once seen tetanic seizures with the hands in the typical accoucheur's position in patients unoperated, while resting in the hospital waiting for operation. The reliable test as to the presence of tetany is the blood-calcium content. Patients showing blood-calcium contents below 7 mg. per 100 c.c. may with certainty be considered as in a state of tetany.

The facial twitch which follows percussion over the root of the facial nerve in front of the ear, Chvostek's sign, is a constant sign in true tetany, but too much significance should not be attached to it in the absence of other signs, since it may frequently be elicited in apparently normal individuals.

Trousseau's sign is of greater value. It is best elicited by placing the blood-pressure cuff on the upper arm and raising the pressure until a tourniquet-like action is produced. The resulting typical accoucheur's hand of tetany leaves no doubt when present. The pressure should be left on for at least five minutes before the reaction is decided to be negative. A tightness of the jaw or heaviness of the tongue are subjective signs of value. Trousseau's sign, however, together with a low blood-calcium are the truest criteria upon which to base a diagnosis of tetany.

Its treatment is by the administration of calcium, by mouth or intravenously. Calcium lactate, 30 grains four times a day, should begin by mouth, and in severe acute cases calcium chlorid,

5 c.c. of a 10 per cent. solution, intravenously. The subcutaneous administration of Collips's parathyroid derivative, parathormone, will dependably and consistently control the symptoms of parathyroid deficiency, and should be used should the condition persist longer than a day or so or, if it is not controlled in the acute phases, by intravenous calcium. Cases of permanent tetany vary in their ability to get on without the daily hypodermic administration of parathormone. For the most part it seems that a tolerance to the low blood-calcium is established, and that less medication is needed as time goes on. One must be on the lookout, however, for the occurrence of latent tetany. A patient may be getting along nicely without symptoms, when, with the occurrence of an acute infection, unusual fatigue, pregnancy, and sometimes with menstruation, the tetany syndrome may reoccur with all its former severity. Patients known to have tetany should be carefully observed at frequent intervals. Routine blood-calcium determinations should be done, and patients warned against the circumstances that may bring on the tetany. In all young adult women who have had tetany, and who are symptomless on a certain dose of calcium, the dose should be increased at each menstrual period.

Fortunately, postoperative infection in thyroid wounds is rare. When it does occur, it is most frequently located anterior to the prethyroid muscles beneath the skin flaps, where it may be quite readily drained. Infections beneath the skin flap evidence themselves by redness, tenderness, and prominence of the region of the flap, and are quite satisfactorily treated by the introduction of rubber-dam strips through small openings in the wound without completely disturbing its approximation. This, together with the application of hot poultices over the flap, will suffice to care for most infections without loss of the line of approximation. When, however, infection is not immediately controlled by this procedure, the skin clips must be loosened, the flap turned up, infection controlled, and the wound closed later by secondary suture.

Infection beneath the prethyroid muscles is a much more serious complication, since, as stated in the paragraphs on ar-

terial hemorrhage, the cavity from which the thyroid has been removed is for all practical purposes a closed one, with the natural direction of spread for the infection downward into the cellular tissue of the superior mediastinum and the production of mediastinitis, a lesion which has been universally fatal in our experience.

When the postoperative temperature after partial thyroidectomy remains high, together with signs of systemic septic intoxication, the neck should be immediately opened, the sutures in the prethyroid muscles cut, drains inserted into the space from which the gland was removed, and hot poultices applied. The quickness with which infections beneath the muscles are found and drained will have much to do with the limiting of the number of fatal cases of mediastinitis which follow infections of this type.

Because of the number of catgut knots which must be introduced beneath the skin flaps, and because of the comparatively large plane of cleavage which must be separated, leaving thus a considerable sized pocket for serum to accumulate in, there will, with our present methods, always be some postoperative accumulations of serum in the wound. These occur, in our experience, anywhere from four to five days after the operation up to two weeks after it. They appear as small, transparent, blister-like bulgings in the scar, or as diffuse prominence of the entire flap, which in such a case will be fluctuant on palpation. The fluid contained in these accumulations will be clear yellowish serum, thin blood-stained serum, thick bloody serum, or seropurulent material. Accumulations of this type are, as a rule, noninflammatory and not associated with any reaction except the occasional presence of slight tenderness over them on pressure. They may be cared for quite painlessly by opening them with a probe. They will frequently need to be opened, by means of a probe, two or three times in the dressing room after the patients have left the hospital, as occasionally it will be necessary to insert a small narrow strip of rubber-dam into the serum pocket, to be retained there for three or four days. This complication, occurring as late in the convalescence as it does, is not materially

lessened by the introduction of a drain. It is quite satisfactorily managed by separating about ½ inch or more of the wound with a probe, and the subsequent spontaneous closure of the opening in line of the scar results in little or no effect upon its appearance.

Adhesions of the scar of the skin incision to the underlying prethyroid muscles may result in unsightly distortion of the natural curve of the wound. The skin scar may become so adherent to the underlying prethyroid muscles that, with each act of swallowing, the scar ascends and descends in an unsightly and disfiguring manner.

While this complication has occasionally arisen, we have not had to reoperate and correct this condition more than three or four times in our experiences with thyroid surgery. Time and firm traction by the patient on the skin just below the point of adhesion have in practically every instance resulted in the loosening of these adhesions, the disappearance of unsightly motion of the scar on swallowing, and the return of the scar to its proper and symmetrical relation to the remainder of the incision. There are certain procedures, however, which may be employed to prevent the occurrence of these undesirable complications. The application of the two clamps to the prethyroid muscles, which are to be cut transversely, should be as high as possible in order that the line of mattress sutures which is to unite these muscles may be as high above the skin suture as possible, thus preventing the formation of adhesions between those two suture lines, and the resulting upward and downward motion of the wound on swallowing. In the same way, to prevent the occurrence of adhesions between the skin scar and the underlying muscles, we now drain all thyroids, when such a procedure is unavoidable, by the introduction of drains through the outer angles of the wounds, where adhesions between the trachea, the prethyroid muscles, and the skin incision is not possible.

Another complication which we not infrequently see is temporary edema and unsightly fulness of the upper flap. We have never had occasion to interfere with this condition, as it has always disappeared within a reasonable, though variable, length of time.

THE INCISION FOR THYROIDECTOMY

FRANK H. LAHEY

THE incision for thyroidectomy is extremely important. In female patients the postoperative appearance of the neck will play a large part in their state of mental happiness, and the type of scars obtained will play a considerable part—whether or not many women will accept the operative procedures that should be carried out upon them. It therefore is obviously necessary that every precaution should be taken to insure that the scar be as presentable as possible.

The shape and curve of the scar should be carefully planned, and if there is any doubt as to how it will look, it should be marked out on the neck by drawing the blunt or handle end of the operating knife across the neck at the level and in the curve selected for the scar. If the neck has previously been prepared with picric acid or with iodin, this procedure will leave a distinct mark which will give a good idea as to how the scar is to appear when the wound is closed. Even when the skin is uncolored by any preparation other than alcohol, the red line which for a few seconds follows this procedure permits one to visualize the shape and location of the contemplated procedure.

In the hands of experienced goiter operators, and on necks that are undistorted by disfiguring thyroid tumors, this trial incision will rarely be necessary. Where, however, the incision must be tilted upward on one side in a compensatory manner, as will later be described, this is of great value. The shape of the incision should be such that a string of beads hanging naturally, but closely to the neck, will cover it when it is healed. There is a tendency on every one's part to turn the outer limbs of the incision upward so that it approaches to some degree the shape of a horse-shoe. This is undesirable and unnecessary.

The incision should be of sufficient length so that when the skin flap is turned upward the upper poles of the thyroid may be readily seen without undue traction upon the skin.

We have in a previous article[1] on the technic of thyroidectomy mentioned the scheme which we have employed for the incision in thyroidectomy. It consists in making the skin incision so lightly that the knife cut passes but part way through the skin, serving later only as a guide along which the incision will be completed by scissors. Following the making of the incomplete incision in the skin, it is deepened with the knife at its center for a distance of $\frac{1}{2}$ inch, so that it passes completely through skin, subcutaneous fat, and platysma muscle. With the edges of this incision grasped in toothed forceps and lifted upward, Metzenbaum scissors may be so inserted beneath the flap that by opening and advancing them gently in either direction throughout the entire extent of the incision, the skin, fat, and underlying platysma muscle may be freed and so lifted away from the prethyroid muscles and their large longitudinal veins, that completion of the incision may readily be accomplished with scissors in such a manner that the jaws of the scissors grasp and cut at one time the marked skin, the subcutaneous fat, and the platysma muscle. This plan is of considerable value in that the large, distended venous channels which run upward and downward upon the prethyroid muscles are not cut, preventing thus the flooding of the wound with venous blood, as occurs when they are cut, and resulting in considerable saving of time lost in controlling this bleeding. There is another advantage in this plan, in that it demonstrates accurately the plane between the platysma and prethyroid muscles, permitting the upper skin-flap after a very slight amount of sharp dissection to be wiped upward with gauze strips in the proper line of cleavage and with little bleeding.

The location of the incision has already been described, and concerning it there is little need for further discussion in symmetrical non-prominent goiters of the exophthalmic type. When, however, the incision is to be made over a prominent goiter one

[1] Surg., Gynec., and Obstet., June, 1923, pp. 825–829.

must have in mind the fact that following the removal of the goiter there will be a considerable amount of redundant skin, fixed at the top and with a tendency to slip downward. It is in this type of goiter that slippage of the scar so often occurs. If, for example, as may be seen in Figs. 1–3, the incision over a prominent goiter be made at or close to the level at which the scar is desired, a little above the level of the sternal notch, following removal of the thyroid mass, the scar as the result of slippage of the redundant skin will descend downward over the chest for

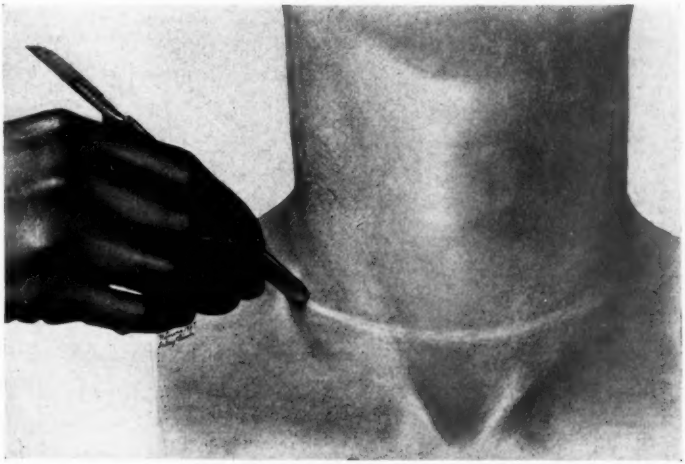


Fig. 1.—The method of visualizing how the proposed incision will appear by marking it out on the iodin-painted neck with the end of the knife handle.

varying distances, depending upon how prominent the goiter was and, thus, upon how much redundant skin there was to slip. This is extremely undesirable, as it results in the scar, originally made at the proper level, eventually coming to lie on the anterior chest wall, well below the level of the sternal notch, where it is unsightly and cannot be covered with beads.

In the same way, given an adenoma of the thyroid occurring in one lobe and producing a marked degree of lateral prominence of the gland, if the incision be made exactly transverse as is the

usual custom, then, due to the fact that following removal of the prominent adenoma there will be a marked skin redundancy on the side of the neck which was prominent, there will be a greater skin slippage upon that side, and the skin incision which was originally transverse and symmetrical will so slip down on the side from which the tumor was removed that the incision will no

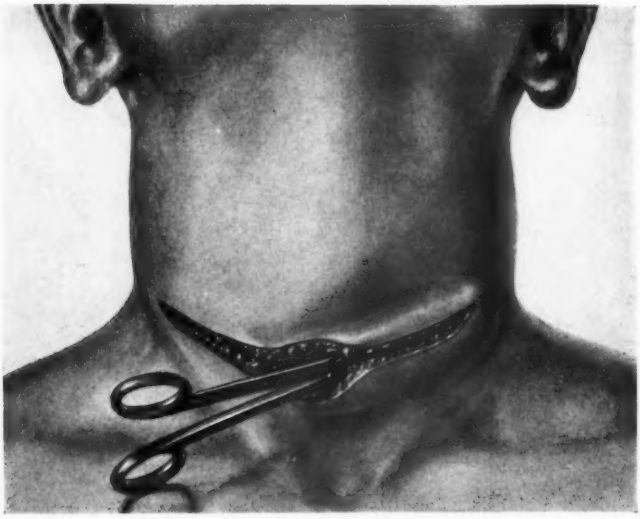


Fig. 2.—The incision made through the skin down to the subcutaneous fat. The central portion of the incision has been deepened through the platysma muscle down to the prethyroid muscles and the scissors inserted beneath the platysma out to the end of the incision, so that platysma is separated from the prethyroid muscles and the cutting of the rest of the skin, fat, and platysma may be completed with scissors.

longer be transverse, but will become more or less oblique, tilting downward upon the side where the skin is redundant following removal of the adenoma.

It is evident, then, that in prominent goiters the incision must be placed sufficiently high in a compensating way to so allow for skin slippage that it will eventually descend to its proper position above the sternal notch, and that in one-sided goiters

a more or less oblique incision must be made so that it will later become transverse.

With the elevation of the skin flap by wiping there will be numerous small bleeding points on the skin edge on the prethy-

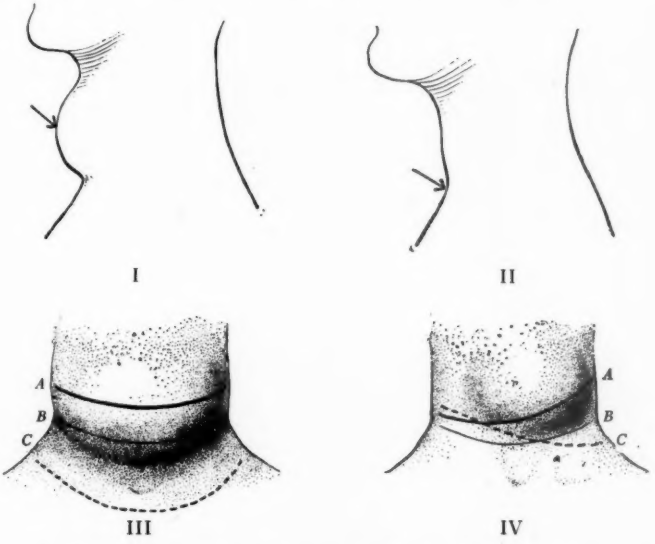


Fig. 3.—I indicates where incision must be made over a prominent goiter in order to eventually have it at the level indicated by the arrow in II. III, The line *B* in this illustration indicates where the incision must be made over a fairly prominent goiter if one wishes it to eventually be at the point *B*. If the incision be made at the point *B* over a prominent goiter, following the removal of the tumor due to skin slippage, the incision will eventually be at the undesirable point *C*. IV, The line *A* indicates how, in a one-sided goiter (adenoma or cyst), the incision must be compensatorily tilted, so that after removal of the tumor and slippage of the remaining lax skin the incision assumes the proper level *B*. The dotted line, *C*, indicates in the same case the unsightly position the scar will eventually assume after removal of the tumor if the incision be made corresponding to the line *B*.

roid muscles, and on the posterior surface of the platysma where it has been separated from the prethyroid muscles. We have given the utmost attention to carefully catching and ligating all of these bleeding points, so that the wound is made meticulously

dry. We have done this to be certain that there is no oozing beneath the skin flap. This is a distinctly unfortunate complication, since it produces a hematoma which later becomes infected, or which requires postoperative opening of the wound and control of the bleeding points. This we feel is very undesirable, particularly in toxic patients, since it necessitates another ordeal for them during the period when they are in the greatest degree of postoperative reaction from the partial thyroidectomy. In severely toxic patients with marked reaction the added ordeal of this small procedure may be of sufficient weight to so intensify the postoperative thyroid reaction as to make it assume dangerous proportions.

Closure of the wound with skin clips has been the most satisfactory method of approximating skin. It has been superior not only in that it has resulted in less disfigurement in the way of prick holes, but requires very much less time to complete. One-half of the skin clips are removed on the third day, and the other half on the fourth day.

If one wishes to obtain scars of good appearance great pains must be taken to make certain of the accurate approximation of cut skin edges to cut skin edges, without gaping areas between the points where the clips are applied. Since skin clips applied for but three to four days leave little or no marking, as many clips as necessary may be applied to bring about this accurate closure.

For several years it was our custom to approximate carefully the cut edges of the platysma muscles with No. 0 plain catgut. We felt that this muscle, which corresponds to the fly-shaker muscle of the horse, by which he wriggles his skin at will, in the same manner could produce traction upon the edges of the incision and bring about widening and separation of the wound. For several years now we have closed goiter wounds, paying no attention whatever to the platysma muscle, making the entire closure anterior to the prethyroid muscles solely by the application of skin clips to the skin. We have closed well over 5000 necks by this method, and have had no cause to regret it. The wounds do not pull apart (there is no traction on the skin) and

the scars have been in no way inferior to those made by suturing the platysma in addition to the skin.

Summary.—Goiter incisions should be nearly transverse with but a slight curve.

Their location should be such that they may readily be covered by beads.

The incision should, in a compensatory way, be made high over prominent goiters and tilted over one-sided goiters, thus allowing for later slippage.

All bleeding beneath the skin flap should be controlled.

It is unnecessary to suture the platysma muscle.

Skin clips have resulted in the least scar in skin closure.

EXCISION OF THE STOMA FOR GASTROJEJUNAL ULCER

FRANK H. LAHEY

IT is an interesting but disturbing criticism of the past and even present methods of determining the value of various operative procedures that the complication of gastrojejunal and jejunal ulcer has received so little attention except in recent years. While occasional references to occurrences of these lesions have appeared in the foreign literature, were one to read the discussions of six to eight years ago on the subject of gastro-enterostomy he would be led to believe that gastrojejunal and jejunal ulcer were extremely rare complications of gastro-enterostomy. Due (1) to the fact that a great many gastro-enterostomies have now existed for a period of many years, thus giving the opportunity for the development of gastrojejunal or jejunal ulcers, and (2) to the fact that every patient upon whom a gastro-enterostomy has been done and followed by a return of symptoms is now strongly suspected of possessing such a lesion and thoroughly investigated for such a possibility, this complicating lesion has been demonstrated as far from rare.

One finds the incidence of these lesions as reported in the literature varying from 2 to 27 per cent. Balfour reports, in a series of one thousand gastro-enterostomies done ten years or over, an incidence of 2 per cent. Eusterman from the same clinic states that in his opinion the probable incidence of gastrojejunal and jejunal ulcer is 5 per cent. Berg and Lewisohn report an incidence of this lesion of $12\frac{1}{2}$ per cent. as proved by operative demonstration of the lesion, and 27 per cent. as suspected from the history and non-operative findings.

Finsterer, Pauchet, and other continental surgeons have reported the percentages of this complication as higher than the average given in American clinics.

It is possible that the true figures representing the probable incidence of gastrojejunal and jejunal ulcer following gastro-enterostomy are somewhere between the two extremes, since patients who are suffering from gastrojejunal and jejunal ulcer are particularly liable to seek operative help from those surgeons who are interested in and operating on this group of cases, thus raising the incidence of the lesion in their hands. On the other hand, the investigation of the postoperative condition of patients as to gastrojejunal ulcer conducted by other than complete personal examination must be somewhat unreliable as to the true incidence of the lesion. One must admit also the definite factor of a disinclination on the part of patients to be resubmitted, and also many surgeons to resubmit patients to further surgical procedures for ulcers, when the first operative procedure has failed or resulted in the reappearance of ulcer symptoms of greater intensity.

The above stated factors have led us—at least for the purpose of aiding us in our decisions for or against gastro-enterostomy in a given case—to take the position that we may with fairness assume that the possible incidence of gastrojejunal or jejunal ulcer as an immediate or late complication of gastro-enterostomy for ulcer is probably between 6 and 10 per cent. It is possible that we may later have to revise our position as to the probable incidence of this lesion, but we have a utilizable figure which we may employ for the present.

While gastro-enterostomy, with an assumed incidence of gastrojejunal or jejunal ulcer of, let us say, 6 per cent., may no longer be employed unhesitatingly as a curative procedure in gastric and particularly duodenal ulcer (it may probably be employed with less danger of gastrojejunal ulcer in gastric ulcer because of its usual, accompanying low acidity), nevertheless it still possesses a very definite place in the surgical treatment of non-malignant ulcers of the stomach and duodenum which have failed to be relieved by adequate medical treatment. It is a fact that partial gastrectomy is at present in some quarters a more popular and possibly a better method of surgical treatment of gastric and duodenal ulcer than gastro-enterostomy.

(An insufficient number of cases as yet exists, however, and for an insufficient period of time, to compare fairly its end-results with those of gastro-enterostomy.) There are, however, a number of patients with obviously non-malignant ulcers of the stomach or duodenum in whom, due to unfavorable factors, such as large deposits of mesenteric fat, a short gastrocolic omentum, lack of anesthetic adaptability, complicating pulmonary, cardiac, and renal lesions, together with extension into the posterior gastric tissue by the eroding ulcer, in whom it is wiser to perform an operation of less immediate satisfaction than to accept the probably unjustifiable immediate mortality of the more radical, but possibly more satisfactory, procedures.

It follows then that the surgeon today who is dealing with gastric surgery must not be irretrievably committed to any given procedure.

If gastro-enterostomy be performed there are certain technical factors which, while undemonstrated as preventing the occurrence of jejunal and gastrojejunal ulcer, nevertheless deserve attention as possibly increasing the incidence of these very undesirable lesions.

Gastrojejunal ulcers have very frequently occurred when catgut was employed throughout the gastro-enterostomy. Nevertheless, the frequent demonstration of silk or linen hanging on the ulcer base, together with the proved fact that unabsorbable suture material has no advantage over absorbable suture material, should cause the careful operator to forego the employment of non-absorbable sutures in this operation.

The cutting away of redundant mucosa either on the gastric or jejunal side of the stoma is of no real advantage and may serve to leave small areas uncovered by protecting mucosa, and should not be done.

There is probably no single step of greater value in gastro-enterostomy than the careful control of bleeding vessels in the stoma edges, together with prevention of hematomata beneath the mucosal edges.

The application of the jejunal loop not too close to the pylorus, together with the employment of the utmost gentleness

and accuracy in the entire procedure, are precautionary measures well worthy of application.

The postoperative medical management of patients upon whom gastro-enterostomy has been performed should be as particular and as persistent as on the ulcer patients who are endeavoring to avoid operative procedure by medical measures.

In spite of these precautions it must be admitted that jejunal and gastrojejunal ulcer will occur. This fact, however, in no way lessens the responsibility of the surgeon in taking every precaution to prevent their possible appearance.

Medical treatment having failed, and at present we do not feel as hopeless regarding this form of treatment as some, jejunal and gastrojejunal ulcer must be submitted to surgery, which may, in order of satisfaction, consist of (1) partial gastrectomy, together with the removal of the involved segment of jejunum; (2) removal of the gastro-enterostomy together with the involved segment of stomach and jejunum, and closure of the stomach and jejunum so that the alimentary canal is restored to its original and normal course; (3) excision of the ulcer from the portion of the gastro-enterostomy that is involved with restoration of the stoma; and (4) jejunostomy alone.

In the patient with a lax, easily delivered stomach, and deemed a good surgical risk, partial gastrectomy may be considered reasonably applicable. The decision, even in such cases, should not be entered into lightly, as they are often more difficult and time consuming than may be anticipated in the beginning. They require in our hands from an hour and a half to two hours, and sometimes longer, to perform. When once undertaken, the plan of procedure does not admit of change, and, no matter what the difficulties or the patient's condition, must be completed in time and extent as originally planned. The mortality of such a procedure must be and is necessarily high.

When uncertainty exists as to the wisdom of partial gastrectomy for gastrojejunal ulcer, it is preferable and safer, we have felt, to limit the surgical procedure to taking down the gastro-enterostomy by excision of the stoma and jejunum including the marginal ulcer.

We have but once had occasion to excise the marginal ulcer itself, with restoration of the original gastro-enterostomy, but we have never performed jejunostomy for jejunal or gastrojejunal ulcer.

The first step in the operative demonstration of gastrojejunal or jejunal ulcer is the separation of the mesocolon from about the point where the jejunum was anastomosed to the stomach. This is best accomplished with the transverse colon turned upward upon the abdomen by gently snipping away the attachment of the mesocolon at one angle of the anastomosis until the lesser peritoneal cavity is opened at this point. The finger may then be inserted into the lesser peritoneal cavity and, acting as a guide, the mesocolon separated from the anastomosis for its entire circumference. Care must be taken at this point lest the middle colic artery be injured in this procedure, a catastrophe which is very easily precipitated owing to the frequent close proximity of that vessel to the anastomosis, and the fact that it may be easily torn by traction on the transverse colon. We have injured the middle colic artery three times in the course of operations for partial gastrectomy. Once it was ligated designedly because of its involvement in the extensive exudate of a gastrojejunal ulcer of long standing and marked extent; once designedly in an ulcer of the posterior wall of the stomach, the exudate of which had involved the lesser peritoneal cavity, the mesocolon, and included the root of the mesocolon; once accidentally, and doubtless avoidably, in a resection for a pyloric ulcer. In all these cases sharply demarked discoloration together with sharply demarked loss of temperature occurred, necessitating in each instance the additional procedure of resection of the transverse colon.

The mesocolon having been freed around the entire circumference of the anastomosis, traction upon the jejunum now causes a considerable portion of the posterior wall of the stomach to protrude through the opening in the mesocolon made by separating it from the anastomosis, exposing thus the anastomosis so that the finger may be passed completely around it. A Schoemaker clamp is applied obliquely to the jejunum on either side

of the stoma so that the points meet at an acute angle on the jejunum halfway between the mesenteric and non-mesenteric borders (Fig. 4). The clamps are then cut away from the jejunum with a sharp knife, the incision made on the jejunal side of the clamps, being carried down one side until it meets the incision of the opposite side, freeing thus the jejunum and

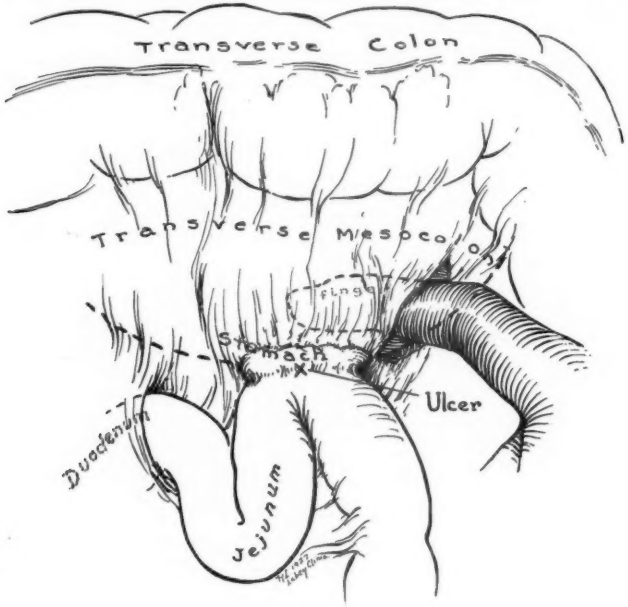


Fig. 4.—Excision of the gastro-enterostomy and gastrojejunal ulcer, showing incision made through gastrocolic omentum and finger inserted into lesser peritoneal cavity preparatory to cutting the gastrocolic omentum away from the stomach just above the anastomosis.

leaving the stomach still closed by the clamps attached to the jejunal cuff.

The jejunum may now be closed quite quickly and very safely by a continuous Connell suture, since but one-half to two-thirds of the caliber of the bowel has been cut and the mesenteric border remains safely intact (Fig. 5).

Following suture of the jejunum, if it is considered wisest to excise the gastro-enterostomy stoma together with the ulcer, a small incision is made in the stomach about an inch from the

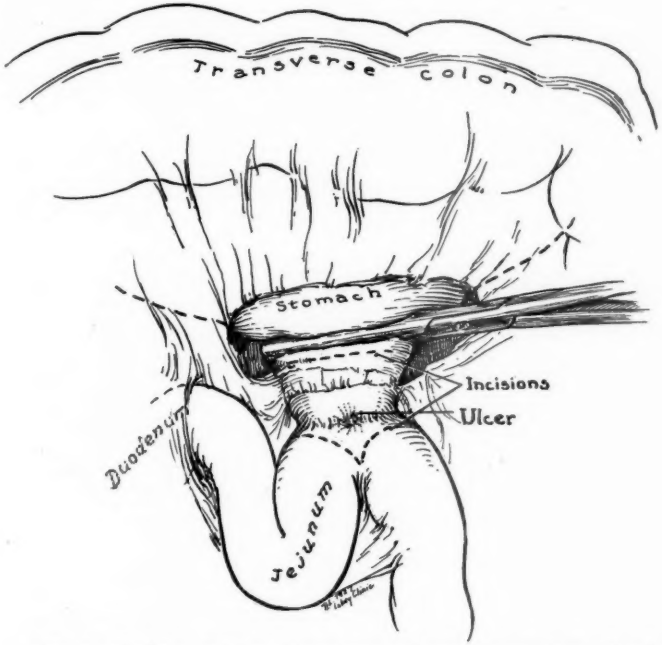


Fig. 5.—Excision of gastro-enterostomy and gastrojejunal ulcer. Showing the gastrocolic omentum freed, the portion of the stomach to which the anastomosis has been made pulled down into a tunnel-like projection, and clamped proximal to the ulcer and stoma. The dotted line on the jejunum indicates the portion of the jejunum which is to be removed with the gastro-enterostomy stoma and the gastrojejunal ulcer. Note that the jejunum is not completely cut across, but that the portion into which its mesentery is inserted remains, thus simplifying suture of the bowel.

line of anastomosis and outside the area of ulcer induration and exudate. Into this a suction tube is introduced, the stomach emptied, and the incision carried completely around the stoma, excising the entire anastomosis with its marginal ulcer, and with

a gastric and jejunal cuff attached. Bleeding vessels on the wall of the stomach are ligated, the gastric opening closed by continuous Connell sutures, and the rent in the mesocolon closed. In many instances it will be possible to apply an Ochsner clamp as shown in Fig. 6, over which a continuous chromic catgut

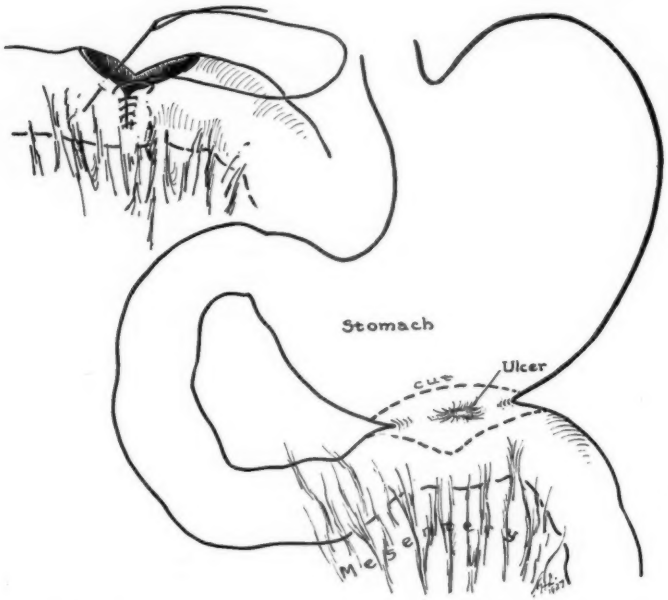


Fig. 6.—The main illustration indicates by dotted line the segment of stomach and jejunum which contains the ulcer and is to be removed. Insert in upper corner shows the simplicity of suture of the jejunum when but one-half or two-thirds of the circumference of the jejunum is incised. As stated in Fig. 5 the mesenteric portion of the jejunum is preserved, thus adding to the safety and simplicity of the jejunal closure.

stitch is inserted before it is withdrawn, thus preventing any soiling with gastric contents.

Should it be decided that partial gastrectomy is to be employed, it is proceeded with in the typical way except that clamps must be applied above the mesocolon to the jejunal cuff at-

tached to the stomach at the gastro-enterostomy opening, since the handles of the clamps attached below do not pass readily through the rent of the mesocolon.

Conclusions.—Gastro-enterostomy, even with its uncertain incidence of gastrojejunal or jejunal ulcer, may be preferable in certain cases, where medical measures have been exhausted, to partial gastrectomy with its high immediate mortality.

Partial gastrectomy, if the patient's condition permits, offers the best chance of complete cure without later complications, at least as far as present available statistics show.

The method employed in this clinic of excising gastro-enterostomy stomata with marginal ulcers, together with the method of closing the jejunum, is described and illustrated.

GASTROJEJUNAL AND JEJUNAL ULCER

FRANK H. LAHEY

Report of a Case.—A. C., an Italian shoe worker of twenty-three years, was seen by us first in February, 1923, complaining of typical symptoms of peptic ulcer, together with consistent findings by *x*-ray and gastric analysis. At operation, then, a peptic ulcer was found on the lesser curvature near the junction of pylorus and duodenum. Posterior gastro-enterostomy was done without incident. He returned to work two months later and remained completely relieved until September, 1925 (two years and eight months). At this time he noticed a fairly constant epigastric pain with occasional radiation to lower abdomen and right side. Nausea came on immediately following eating, relieved by vomiting, the vomitus consisting of normal gastric contents. The pain usually lasted until two to three hours after eating. There was considerable gas, with belching and epigastric distress. There was no relief from the usual measures. He was admitted to the Deaconness Hospital in October, 1925, and placed on medical ulcer management, with improvement. There was *x*-ray evidence of gastrojejunal ulcer with delay in emptying through the new stoma. Operation was done November 4, 1925, at which time the pylorus was normal with no evidence of active ulcer. The gastro-enterostomy stoma admitted two finger tips, but a definite crater 1 cm. in diameter was found on the anterior margin of the stoma. The gastro-enterostomy was taken down in the manner described in another paper in this number.

Postoperative convalescence was uneventful. He was placed on a full ulcer diet on discharge. Three *x*-ray check-up examinations two, six, and ten months postoperatively showed a relatively normal stomach, emptying readily. He was last seen in November, 1927, at which time he was completely relieved.

While the first gastrojejunal ulcer was reported in 1899 by Braun, it is only of late years that we have heard the subject so vigorously discussed. This is perhaps due to better investigation of cases suspected of this lesion, and to the fact that a very large number of gastro-enterostomies have been done in the past twenty to twenty-five years, resulting thus in a great number of opportunities for this lesion to occur, since in our experience the lesion has occurred anywhere from six months up to twelve years after the performance of gastro-enterostomy, and probably in 6 to 10 per cent. of the cases.

We wish particularly to call attention to this lesion because of its tendency to produce perforation into the free peritoneal cavity (approximately 35 per cent. of the cases), to produce a fistulous communication between the stomach, jejunum, and transverse colon by perforation into that viscus (approximately 10 per cent. of the cases), and because of the fact that the symptoms of gastrojejunal or jejunal ulcer are of much greater intensity than those of the original ulcer, frequently resulting in practically complete disability, and yielding much less satisfactorily to medical measures than the original duodenal or gastric ulcer for which the gastro-enterostomy was done.

Gastrojejunal ulcers have occurred in our operative experience at the gastro-enterostomy stoma, in the jejunum just opposite the gastro-enterostomy stoma, in the jejunum proximal to the gastro-enterostomy stoma, and in the jejunum distal to the gastro-jejunal stoma. We have demonstrated the lesion at operation for it as early as six months after the gastro-enterostomy had been performed, and as late as fourteen years after it had been performed.

When, following the performance of gastro-enterostomy for gastric or duodenal ulcer, there has been a period of relief from symptoms followed by a recurrence of the symptoms, there frequently is an inclination to assume that the symptoms are the result of the reactivation of the original gastric or, more frequently, duodenal ulcer. This attitude, we believe—for the purpose of more careful search for gastrojejunal and jejunal ulcer—should be changed to the assumption that this sequence of events

indicates with greater probability the presence of a new ulcer in the form of a gastrojejunal or jejunal ulcer, rather than the reawakening of the original ulcer in the duodenum or stomach.

Given, then, a patient with active symptoms and duodenal ulcer as proved when the operation of gastro-enterostomy is done, in whom relief follows the operation only to be followed by a return of ulcer symptoms of greater intensity than the original ones, one's attitude should be that in all likelihood the symptoms are due to gastrojejunal or jejunal ulcer, and every possible diagnostic measure employed to settle the question of presence or absence of this lesion.

It is extremely important, we believe, to settle, in so far as is possible, whether or not postgastro-enterostomy ulcer symptoms are or are not due to gastrojejunal or jejunal ulcer, since the stoma ulcer is a much more serious lesion with its tendency to perforate and to invade neighboring structures, with much more definite indications for surgical treatment and much more difficult ulcer to deal with surgically.

In the diagnosis of this lesion pain has been the outstanding diagnostic feature in our cases. The pain has been of marked intensity, at first relieved by alkalies, but later showing little or no benefit following the employment of alkalies as a relief measure. Two cases of long-standing stoma ulcers have become morphin addicts, and 3 cases were completely incapacitated for all work.

The location of the pain has been nearer the midline and closer to the umbilicus than the original ulcer pain. There has been frequent tenderness over this area, which by fluoroscopy has been shown to correspond to the point approximately opposite the location of the gastro-enterostomy stoma.

There has quite constantly been a high gastric acidity and occult blood in the stools.

x-Ray has shown gastric hypermotility, occasionally with deformity of the gastro-enterostomy stoma, and a few cases have shown a persisting fleck of bismuth at the stoma. This latter point is, we believe, of marked value when, on pressure directly over this point marked by the fleck, tenderness may be elicited, as is demonstrable by palpation during fluoroscopy.

A trial of medical treatment possesses a certain amount of diagnostic value in that there are few duodenal or gastric ulcers which may not at least be relieved temporarily by the administration of an adequate amount of alkalies, while the reverse is undoubtedly a fact in many gastrojejunal and jejunal ulcers.

We have been able to diagnose gastrojejunocolic fistula in but one case, in which bismuth was seen to trickle from the stomach directly into the transverse colon. It is to be suspected in any patient who has had a gastro-enterostomy and who vomits foul or fecal smelling material. The size of the fistulous canal between the stomach, jejunum, and colon varies from a minute tract up to an opening which will admit a finger. In a case possessing a fistulous tract of the latter caliber, emaciation may become a prominent feature of the condition, due to the fact that stomach contents are in a large part passed directly into the transverse colon, without opportunity for assimilation. Bismuth enemata may show part of the bismuth making its way along the fistulous tract into the stomach, or shortly after the introduction of the bismuth enema a mass of bismuth may be demonstrated within the gastric cavity.

Colored enemata may occasionally be demonstrated by the stomach-tube to have rapidly reached the stomach and, vice versa, colored meals may by enemata be demonstrated to have rapidly reached the colon.

The decision in favor of the employment of surgical measures in gastrojejunal ulcer and gastrojejunocolic fistula will often be settled by the severity of the symptoms, and by the complete failure of non-operative relief measures.

We believe, from our own operative experiences with these ulcers, that the surgical treatment of gastrojejunal ulcer should not be delayed in the face of failure of non-operative relief measures. The formation of a fistulous connection between the stomach, jejunum, and transverse colon is, in all probability, more common in the long-standing cases, and results in a serious surgical problem, the operative risk of which is approximately 50 per cent.

The location of the gastrojejunal and jejunal ulcer in the

jejunal fossa and close to the root of the mesentery of the small intestine is such that the exudate, which so frequently surrounds the stoma ulcer, not uncommonly involves the adjacent loops of high jejunum and the posterior leaf of the gastrocolic omentum, factors which seriously complicate the satisfactory surgical management of this dangerous and trying lesion.

Conclusions.—The recurrence of ulcer symptoms following gastro-enterostomy necessitates the consideration of gastro-jejunal or jejunal ulcer as a serious possibility.

All patients with possible gastrojejunal or jejunal ulcers should be investigated for the possibility of gastrojejunocolic fistulæ.

Unsatisfactory non-operative relief measures in these lesions should not be persisted in over any period of time, because of the tendency for the occurrence of complicating conditions which make surgical relief measures less satisfactory and more dangerous.

ESOPHAGEAL PULSION DIVERTICULUM

FRANK H. LAHEY

W. S., an American male dancing master of seventy-two years, came to the Clinic in June, 1926, complaining of dysphagia, regurgitation of food, and loss of weight. Ten months previously he began to notice solid food sticking in his throat, causing him to choke. This became more marked after a few weeks, with regurgitation of food and frothy mucus one-half to one hour after eating. On rare occasions he would bring up particles of food eaten the night before. He then noticed a swelling on the left side of the neck and learned that he could relieve himself by pressing upon this lump, emptying it into his mouth. He lost 15 pounds in weight and became considerably weaker, although his appetite remained good.

x-Ray examination showed a typical diverticulum of the esophagus on the left, extending into the mediastinum.

Operation (first stage) was performed at the Deaconess Hospital, June 10, 1926, under local anesthesia. Incision was made along the anterior border of the sternomastoid muscle, retracting it backward, and the omohyoid muscle was divided. The diverticulum was identified by carrying the dissection lateral to the thyrohyoid muscle, beneath the left lobe of the thyroid gland. With the aid of occasional swallowing by the patient, the sac of the diverticulum was freed from its bed in the mediastinum and brought out on the side of the neck. The neck of the sac was cleared and sutured to the muscles. A cigarette drain was placed down to the mediastinum and the skin closed about the sac.

Diet was restricted to liquids and soft solids, which were taken easily. The second stage was done June 22, 1926, twelve days later, with excision of the sac under local anesthesia.

Sixteen days after completion of the second stage operation, the wound was perfectly healed, he was gaining weight, and could eat any form of food. He was then sent to Dr. Crosby Greene for passage of bougies.

We have in three different articles discussed the subject of esophageal pulsion diverticula, and have now operated upon 13 such cases with no mortality.

This condition, while by no means rare, is still so sufficiently uncommon that it is often diagnosed late, and frequently permitted to go on for such a time, because of fear of the operation, that the sac reaches large proportions and descends deeply into the mediastinum, as does an intrathoracic goiter, making its complete dissection and delivery difficult and trying. We would, therefore, urge that any patients showing any symptoms suggestive of esophageal obstruction be investigated by means of a bismuth meal for the possibility of esophageal pulsion diverticulum.

Pulsion diverticula must of course be distinguished as a group from another group of esophageal diverticula—the traction diverticula—which occur most commonly at or about the level of the bronchi or close to the diaphragm level, and do not lend themselves favorably to surgical measures. Pulsion diverticula always occur typically at the same level and usually with their sacs enlarging toward the same side, the left.

The explanation as to why they should occur is not entirely clear, but the fact that they bulge out always from the same point, from the posterior pharyngeal wall, the pharyngeal dimple, indicates at least that there must exist a congenital weakness or defect in the pharyngo-esophageal wall at this point.

The pharyngeal dimple, so called, is a small, more or less triangular area on the posterior wall of the pharynx, bounded above by the lowest fibers of the inferior constrictor muscle and on the other side by the oblique fibers of the cricopharyngeal muscles, as they separate laterally from the lowest fibers of the inferior constrictor on the sides to come together in the midline a short distance lower down. It is at this point that the necks of all esophageal pulsion diverticula are found at operation.

The symptoms of diverticula of this type are divisible into three groups, which are related to the size and development of the diverticular sac.

The diverticulum sac may be demonstrated at operation or by *x*-ray to fall into one of the following groups:

1. The group in which the esophageal wall has just begun to bulge, but has not as yet resulted in the formation of a real sac.

2. The group in which a sac has fully developed, but has not reached such proportions as to cause esophageal obstruction.

3. The group in which a large sac has already developed and so descended into the mediastinum that by traction and pressure, esophageal obstruction results.

In group 1, the symptoms are of necessity slight, since there is no real sac, and consist of a sense of things sticking in the throat, with more or less hawking in an attempt to dislodge small particles of food which have become lodged in the small recess in the esophagus. Small diverticula of this type which are of sufficient size to produce symptoms may be demonstrated by *x*-ray, with thin bismuth mixtures, as a slight projection from the posterior wall of the esophagopharyngeal junction.

Group 2, consisting of a definitely formed sac, but without obstructive symptoms, produce a much more tangible and definite set of symptoms. In this group particles of food taken at a previous meal and mixed with mucus may be expelled from the sac by hawking or by pressure on the side of the throat. A gurgling noise due to air in the sac may be heard in the neck on swallowing. Swallowing may be difficult until a sufficient amount of food has been taken to fill the sac. The sac is readily demonstrable with a bismuth mixture and *x*-ray, appearing as a round or pear-shaped shadow in the midline, or inclining toward the left. It will show a definite fluid level near the top of the sac, representing the top of the bismuth mixture as it rests in the diverticulum. In this type, the opening from the sac into the esophagus will be either entirely lateral on the wall of the esophagus, or more or less obliquely placed in this position.

Group 3 consists of a large, fully developed diverticular sac,

extending well down along the esophagus, and passing behind it as the sac descends for varying distances into the mediastinum.

It is in this group that the symptoms of group 2 plus those of esophageal obstruction are often found. The obstructive symptoms are, in the beginning, difficulty in swallowing dry and solid food and, later, as the obstruction becomes more complete, difficulty in swallowing liquid food with progressive weight loss and inanition. Bismuth *x*-ray in this group readily demonstrates the large sac and its position in the mediastinum.

It is in this type of diverticulum, as we have elsewhere described, that the opening into the neck of the diverticular sac is no longer upon the lateral wall of the esophagus, or even in the semilateral or oblique position but, due to the downward drag of the food-filled sac, is in the transverse position with the mouth of the sac gaping open in the direct line of descent of food, the opening of the true esophagus having been distorted into a lateral position.

While palliative treatment of esophageal pulsion diverticula by bougie dilatation will undoubtedly benefit many cases, in which the sacs have not reached the mediastinum and resulted in markedly obstructive symptoms, nevertheless surgery must eventually be undertaken to prevent progressive enlargement of the sac with later symptoms of an obstructive nature. For this reason, then, and because operative procedures upon this lesion are much more simple when at the stage where the sac has not as yet entered the mediastinum, dilatation as a method of treatment in esophageal pulsion diverticulum should not be persisted with after a real diverticular sac has once developed. With the operative treatment of esophageal pulsion diverticulum as safe as it now is by means of the implantation and two-stage procedure, there is no excuse for the further occurrence of the enormous intrathoracic diverticular sacs which we have seen in the past, except where patients stubbornly reject surgical assistance and assume responsibility for the occurrence of such large and troublesome diverticula.

The mortality of the operative treatment of esophageal pulsion diverticula is almost solely confined to the matter of

leakage from the sac, soiling and infection of the tract from which the diverticulum has been removed, and the development of a fatal mediastinitis.

The employment of the implantation of the sac procedure, with later second stage removal, has practically eliminated the danger of mediastinitis, and the ease with which the operation may be carried out under local anesthesia has, likewise, practically eliminated the danger of shock and pulmonary complications in the debilitated patients, and made possible its application without hesitancy in patients of markedly advanced years. The ages of the patients upon whom we have operated have been: Males, sixty-one, sixty-eight, seventy-two, fifty-five, fifty-four, forty-two, eighty, seventy, and sixty. Females, eighty-one, seventy, seventy-six, and fifty-five.

It is a fortunate circumstance that there is very little pain sense in the esophagus and sac of the diverticulum, thus necessitating only the infiltration of the skin and muscle layers down to the level of the diverticular sac. This is readily accomplished by infiltration of these layers along the anterior border of the sternomastoid muscle. With the dissection carried down to the level of the left thyroid lobe, the procedure from there on is practically without pain, and no further infiltration is necessary.

The procedure of delivery of the diverticular sac is extremely simple, if it be small, without adhesions, and has not descended into the mediastinal cavity.

The ease with which the sac may be exposed is somewhat dependent upon the size of the left lobe of the thyroid gland. In certain cases it will be necessary to ligate the middle thyroid vein and rotate the left lobe of the thyroid gland inward toward the trachea, so that the region of the esophagus can be exposed. Occasionally with deep-lying intrathoracic sacs it will be necessary to ligate the inferior thyroid artery, as it passes from behind the common carotid artery, to enter the lower and middle portion of the thyroid lobe.

With the sac exposed, by gentle traction and dissection, the sac is dissected from its bed and from its attachments to the lateral wall of the esophagus, until it is completely free and

hanging only by its neck. Great care must be employed in dissecting the sac free from its adhesions to the wall of the esopha-

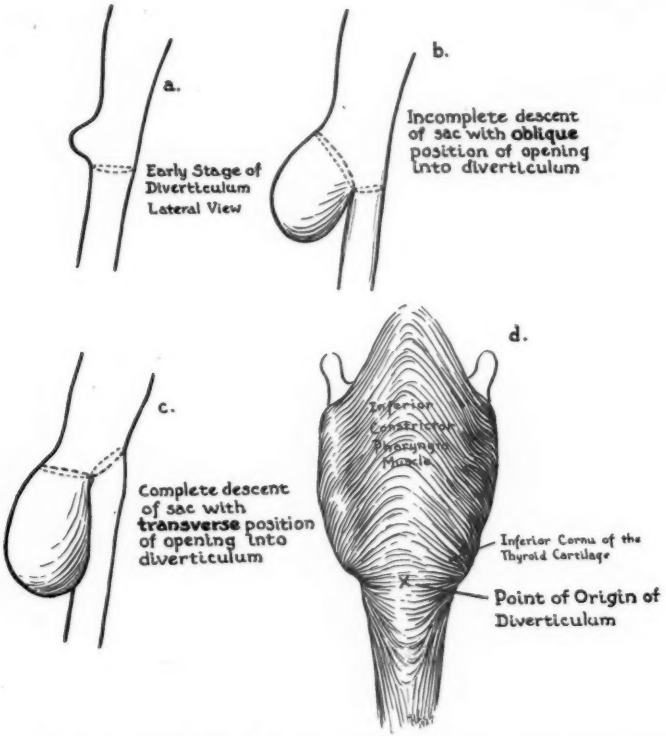

a.
Early Stage of Diverticulum
Lateral View
b.
Incomplete descent of sac with oblique position of opening into diverticulum
c.
Complete descent of sac with transverse position of opening into diverticulum
d.
Inferior Constrictor Pharyngis Muscle
Inferior Cornu of the Thyroid Cartilage
Point of Origin of Diverticulum

Fig. 7.—*a*, Showing the earliest stage of the pulsion diverticulum when there is merely a bulging of the posterior wall of the esophagus at the pharyngeal dimple. *b*, Showing the formed sac, but without marked descent of the sac, and with the opening into the diverticulum still lateral or semilateral. Note that the opening into the esophagus is still transverse. *c*, Showing complete descent of the sac. Note that due to downward traction the opening into the sac has become transverse and the opening into the esophagus oblique. *d*, Showing the pharyngeal dimples between the lower fibers of the inferior constrictor and the oblique fibers of the cricopharyngei.

gus at its neck, so that the dissection is not carried through the sac wall, the sac punctured at the neck, and its contents spilled,

with the further danger of later leakage when the sac is implanted in the wound.

With the sac free, a cigarette drain is inserted into the cavity from which the sac has been removed, and the wound edges closed about the unopened sac in such a manner that the main portion of the sac is implanted at a higher level than the neck of the sac.

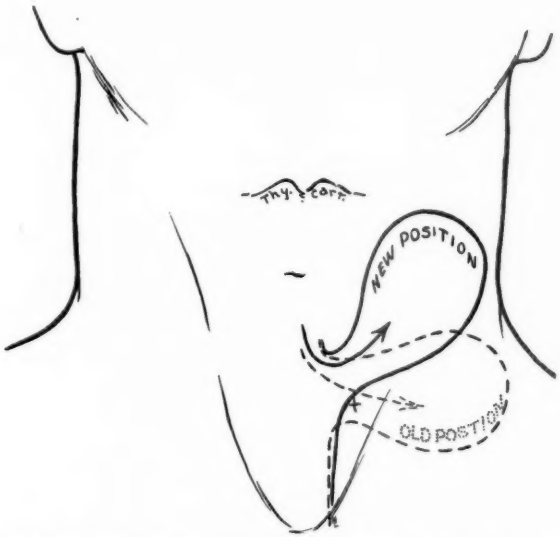


Fig. 8.—The scheme of implanting the sac of the diverticulum high in the neck (solid line) as compared with the hitherto employed plan of implanting it in the horizontal position (dotted lines). Note that the high implantation obliterates the inferior angle at the neck of the sac—marked with a +—and that, as compared with the old horizontal implantation, food does not tend to pass into and accumulate in it.

We have not spoken of this procedure of high implantation of the sac previously, and wish particularly to call attention to its advantage. By this scheme, the tendency of food to enter and accumulate in the implanted sac during the ten to twelve day interval between the implantation and later excision of the sac is largely overcome. This tendency of food to enter and

accumulate in sacs, which have been implanted in the transverse position, has in our past experience with these cases been quite troublesome, necessitating the opening and and drainage of the sacs in two of the cases at an earlier time than we considered desirable.

The drain in the mediastinum may be removed on the fourth or fifth day and replaced with rubber dam, and on the tenth to twelfth day the implanted sac may be cut away down to the level of the point where it joins the esophageal wall.

The removal of the sac itself may be accomplished almost entirely without pain, since the dissection is carried out between submucosa and muscularis.

As the result of the edema which occurs in the implanted sac, its walls become markedly thickened, so that the separation of muscularis from submucosa may be accomplished without difficulty and with but little bleeding. When the sac has been freed well down to its neck, it is cut off at the wound, packed with boric ointment gauze, and left to granulate until complete closure has taken place. Even with large sacs there has never been really troublesome leakage, and complete closure of the wound by granulation has rarely taken more than from two to three weeks at the most.

Due to the fact that the same factors which originally produced the condition are still present, it is advisable to employ postoperative esophageal dilatation every few months, and to continue dilatation for a long time, should there be the slightest complaint of difficulty in swallowing food.

We would recall to the minds of surgeons dealing with these lesions the point which we have made use of ourselves, and which we originated and for the first time described in a recent article on this subject in Surgery, Gynecology, and Obstetrics. It is the introduction of a tube into the stomach through the opening of the sac of the diverticulum, after it has been delivered and freed. By carefully walling off the wound, a purse-string suture may be inserted into the very apex of the diverticular sac, a small puncture opening made, and a catheter passed through the sac and guided down the esophagus into the stomach, and fixed

by suture to the sac wall in this position. The muscles and skin edges may then be approximated around the sac to bring about its implantation and exteriorization, and the wound dressed with strips of sterile, boric ointment gauze.

The procedure described in the previous paragraph eliminates any necessity of preliminary gastrostomy, since with local anesthesia no patient is in too poor condition to permit its application and the immediate introduction of food and fluids. This procedure can immediately be made use of, also, if there is the slightest difficulty in swallowing postoperatively after the implantation of the sac.

Conclusions.—Esophageal pulsion diverticula are by no means rare, and any change in swallowing should cause immediate investigation as to their possible presence.

Under local anesthesia, implantation of the sac and two-stage removal, no patient is too bad a risk for the operation, and with the introduction of a tube through the diverticular sac into the stomach, a preliminary gastrostomy is not necessary.

DIAGNOSIS OF EARLY MALIGNANCY OF THE COLON

SARA M. JORDAN

Two facts lend interest and importance to a review and summary of the symptomatology of malignancy of the colon. First, the frequency of its occurrence—statistical reports indicating that it occurs almost as often as cancer of the stomach; and second, the value of surgery in early malignancy of the colon, which is in over nine-tenths of the cases a slowly growing lesion, where resection and anastomoses can readily be done, with a good life expectancy for the patient.

It becomes, therefore, the task of the family physician, as well as of the surgeon and gastro-enterologist, to evaluate indefinite abdominal symptoms, and to use all possible diagnostic measures for detection of the early colonic cancer.

The symptomatology of cancer of the colon depends upon the character and location of the tumor; its size and shape; whether it encircles or encroaches upon the lumen of the intestine; whether it is ulcerative or non-ulcerative; whether it has destroyed a large area of absorptive mucosa or muscle tissue, with or without perforation; whether it is located in the proximal or in the distal half of the colon.

The symptom which has been most widely known among the medical profession and the laity is alternating diarrhea and constipation. It is a diagnostic sign of significance, and its presence must be regarded as an indication for careful study, with a question of malignancy. This syndrome is much more frequently found in cancer of the distal half of the colon with partial obstruction; while diarrhea alone is a characteristic symptom of cancer in the cecocolon where the intestinal contents are fluid. The cycle of constipation-diarrhea may be explained as follows: When a portion of the distal colon is incompletely obstructed by an annular lesion, or one which en-

croaches upon the lumen, partially dehydrated material is held there for a time with resulting constipation, until sufficient accumulates to force its further propulsion and the dessicated material is finally passed from the rectum. Later, the overstimulated bowel passes along the material which is still fluid, until the same cycle recurs.

In the early case on the proximal side of the colon where there is little obstruction, absorption of fluid does not occur in sufficient degree to cause the accumulation of partially dehydrated material, and material is usually passed readily through the cecocolon. Absorption is, however, incomplete because of the involvement of the absorbing mucous membrane in the new-growth. Furthermore, ulceration and the imperfectly digested material cause irritation resulting in diarrhea.

Obstruction, an ultimate symptom in all colonic carcinomata, may be either chronic or acute. The chronic type is slowly progressive with the increase in growth of the encroaching lesion, which depends upon the type of pathology. Acute obstruction is usually due to swelling from an inflammatory process secondary to the malignancy, or to the sudden filling of a stenosed lumen by dehydrated feces. The degree of stenosis sufficient to cause obstruction may be much less marked in the distal colon, where partially dehydrated material is passed, than in the proximal colon, where the fluid material easily passes through even a narrow lumen. Intussusception or volvulus may occur in association with a tumor mass, and cause sudden acute obstruction.

Blood *in* the stool occurs in the presence of an ulcerating carcinoma in any portion of the colon, but it is found *on* the stool only where the lesion is in the distal loops of the intestine or rectum. Blood in the stool is in itself of little value as a diagnostic aid, as it can come from any area in the alimentary tube. Microscopic examination of the sieved stool, however, may reveal pieces of tumor tissue which have been ulcerated off. Pus may be found in association with blood, but it is pathognomonic only where fragments of tumor tissue are also present, inasmuch as blood and pus are common findings in other ulcerative lesions of the colon.

Mucus passed with the stools or between stools is present in so many other forms of intestinal disorders, that it cannot be considered a characteristic sign of malignancy.

Gaseous distention and borborygmus of recent onset, especially where there has been no history of colitis or cause for colonic irritability, require investigation with regard to malignancy, inasmuch as these symptoms are characteristic symptoms of malignancy, being due to dilatation and atony of the intestinal wall above a partially obstructive new-growth, or to irritation from imperfectly absorbed intestinal contents.

Except in the young individual with neurotic tendency, who has acquired the habit of eructing gas, and whose abdominal symptoms are at once relieved by bowel management, it is, in our opinion, necessary to consider malignancy of the colon or stomach as a possible diagnosis in all cases who complain of distention and borborygmus (Figs. 16, 17).

Pain in malignancy of the colon is a characteristic symptom, and as a rule is found much earlier in the course of development of cancer of the flexures and distal colon than in that of the cecocolon. Unfortunately, it is usually late in occurrence. The cause of pain is first obstruction; and second, injury to the ulcerating lesion from dessicated fecal material. This is especially true of the sigmoid or the splenic flexure, where stricture due to new-growth adds a further difficulty to the mechanical difficulty of passage of formed material through a flexure.

Pain from encroachment of the lesion on surrounding structures, as in involvement of bladder and uterus in sigmoid lesions, and of the greater curvature of the stomach in splenic flexure lesions, is present only after other symptoms have made possible a diagnosis of carcinoma of the colon. Localized tenderness is in most cases present rather early in the course of malignancy, but becomes much more severe when there is secondary infection and lymphatic involvement.

Both pain and tenderness are present in so many other forms of colonic disease, as in the simple functional disturbances and in colitis, that they are not in themselves of great significance.

Tumefaction localized in the colon is due rarely to a fecolith;

occasionally to tuberculosis; most frequently to a malignant new-growth. Many patients notice no abnormal conditions in the abdomen until a tumor mass is felt. The tumefaction is frequently tender and, in all but the late cases, movable.

The secondary symptoms of anemia, indigestion, and loss of weight are late in malignancy of the distal portion of the colon, but may occur early in the course of cecal new-growth. This is especially true of anemia, which may be surprisingly profound in an early and easily operable new-growth of the cecum, and absent in a well developed cancer of the descending colon. The probable explanation of this phenomenon is the intoxication resulting from absorption from a new-growth on the cecocolon side, as contrasted with the development of a lesion in the non-absorptive region of the colon without constitutional invasion. An unexplained secondary anemia, therefore, even without the presence of a palpable tumor, should always lead to an investigation of the colon.

Indigestion and loss of weight are late symptoms in the distal colon lesion, but may be early attendants upon the cecocolonic cancer. They also are due to intoxication from absorption of toxic products of the ulcerative mass, and failure of absorption of food products in the cecocolon.

Cancer of the colon must be differentiated—first, from inflammatory lesions, such as appendicitis with abscess formation, diverticulitis, and colitis; second, from tuberculosis, syphilis, and actinomycosis; third, from functional disorders.

In differential diagnosis, the history is valuable in differentiating appendicitis and colitis from carcinoma; a sudden onset of symptoms sometimes indicating appendicular disease, while a long history of intestinal disturbances with abnormal stools often indicates the presence of a long-standing colitis with resultant deformity of the colon. The history and laboratory evidence are helpful in diagnosis of tuberculosis, syphilis, and actinomycosis. *x*-Ray evidence is of prime importance in the differentiation of functional disorders of the colon which might be confused with malignancy.

The safest application of *x*-ray evidence to the diagnosis of

malignancy is by means of the barium enema. The chronic obstruction due to stenosis of a part of the bowel may be converted into an acute obstruction by a plugging of the lumen with a mass of barium from above. It is, therefore, wiser to first use a barium enema in all cases where carcinoma of the colon may be suspected. The *x*-ray evidence indicating malignancy is either a failure of the barium enema to pass beyond a certain point in the colon, or a filling defect, due to stenosis of the involved area, with dilatation of the portion of the colon proximal to this area.

The failure of the barium to pass beyond a certain point may be due to spasm of the intestinal wall as well as to an invasion of the wall by organic lesion. It is, therefore, often necessary to manipulate the patient by rotation and by palpation of the colon. The patient with organic obstruction is often unable to retain even the portion of the enema which fills the colon below the obstruction. With failure even after these measures, it is advisable to discontinue all procedures for that day, and attempt to fill the colon at a later time. It is not uncommon to find that what appeared to be an organic stricture on one day, is absent in a subsequent observation, and is due entirely to a spasm of the intestinal muscle. On the other hand, a small stricture of the colon accompanied by marked dilatation and atony, may sometimes be concealed by the overlapping of the dilated colon, and may be confused with a purely functional defect.

The following figures illustrate: (1) types of carcinoma of the colon (Figs. 12–16); and (2) types of cases where carcinoma must be suspected, but other types of lesions are found on investigation or laparotomy (Figs. 9, 10, 11, 17, 18, 19, 20).

Fig. 9. Case of appendix abscess. Tumor mass in right lower quadrant. Failure of lower pole of cecum to fill. Man of forty years. History of lower abdominal distress of two weeks' duration and tenderness throughout abdomen on walking. No fever, no nausea or vomiting. Patient ambulatory and in good general condition. Barium enema showed failure of cecum to fill regularly. Operation revealed appendix abscess.

Fig. 10. Case of tuberculosis of the cecum. Tumor mass in right lower quadrant. Male patient of forty years. History of

two years of constipation and generalized abdominal pain. Mass noticed for three months. Barium enema showed irregular filling of cecum consistent with carcinoma or tuberculosis. Operation revealed tuberculosis of cecum and terminal ileum.

Fig. 11. Fecolith lodged in lower pole of cecum. Male patient, thirty-four years. History of having noticed a mass in right lower quadrant five weeks before admission. No tender-

Fig. 9.—Case of appendix abscess.

ness or pain. Constipation of long duration. Barium enema showed failure of lower pole of cecum to fill. Large fecolith, size of egg, was removed at operation.

Fig. 12. Carcinoma of cecum and ascending colon. Man of fifty-five years. History of soreness in right flank of six months' duration, with slight shifting pain in lower abdomen. No constipation or diarrhea. Red blood-count, 3,920,000. Loss of 20 pounds in six months. Barium enema showed filling defect of

Fig. 10.—Case of tuberculosis of the cecum.

Fig. 11.—Fecolith lodged in lower pole of cecum.

upper pole of cecum and ascending colon. Non-removable carcinoma found at operation. Ileocolostomy done.

Fig. 13. Carcinoma of hepatic flexure. Female patient, sixty-nine years. History of attacks of sharp intermittent pain in upper midabdomen, radiating to right upper quadrant; relief from rest and heat. Nausea and vomiting, especially on bending forward. Swelling in right side noticed by patient when pain is

Fig. 12.—Carcinoma of cecum and ascending colon.

present. Pressure of swollen area caused rumbling and gurgling. Constipation and daily catharsis for fifty years. Loss of 10 pounds in two months. Barium enema revealed filling defect of hepatic flexure. Lesion inoperable. Lateral anastomosis done.

Fig. 14. Carcinoma of transverse colon. Male patient of fifty-four years. History of pain in right upper quadrant, intensified by exercise. Six months' duration. No constipation or diarrhea. Physical examination revealed mass in right upper

Fig. 13.—Carcinoma of hepatic flexure.

Fig. 14.—Carcinoma of transverse colon.

quadrant which had not been noticed by patient. Barium enema showed irregularity of transverse colon just distal to hepatic flexure. Operation revealed carcinoma of transverse colon. Resection, lateral anastomosis, and cecostomy done. Patient well eighteen months later.

Fig. 15. Carcinoma of splenic flexure with complete obstruction. Barium enema cannot be made to pass beyond the

Fig. 15.—Carcinoma of splenic flexure with complete obstruction.

upper portion of the descending colon. Female patient, thirty-eight years. History of cramp-like pain of nine months' duration attended by constipation and anorexia. Barium enema showed obstruction just distal to the splenic flexure. Operation revealed carcinoma of splenic flexure. Resection and anastomosis done.

Fig. 16. Carcinoma of sigmoid. Female patient of forty-nine years. History of more than ten years' constipation and daily catharsis. No abdominal pain. Barium enema showed

Fig. 16.—Carcinoma of sigmoid.

Fig. 17.—Shows functional atony and dilatation of colon.

dilatation of colon with lesion of sigmoid obscured by dilated colon. Area of constriction noted during filling and emptying of colon. Operation revealed carcinoma of sigmoid.

Fig. 17. Shows functional atony and dilatation of the colon —to be contrasted with Fig. 16. Male patient sixty-three years. History of fifteen years' constipation and daily catharsis. Nausea, occasional vomiting, tenderness in left side of abdomen. Barium

Fig. 18.—Diverticulitis of sigmoid.

enema showed extreme dilatation and atony. No organic lesion. Complete relief of symptoms, and restoration of tone in intestinal muscle by medical management.

Figs. 18, 19. Diverticulitis of the sigmoid. Female patient of fifty-eight years. Previous laparotomy for acute appendicitis revealed presence of tumor mass in left lower quadrant which had been diagnosed as carcinoma. Patient admitted to the Clinic for surgery. Investigation with barium enema showed a rigid

area in the descending colon, shown by the arrows; and after evacuation of the enema (Fig. 19) diverticular formations. Diagnosis: Diverticulitis. Medical treatment.

Fig. 20. Stricture of sigmoid due to fibrous bands. With exploratory laparotomy no organic lesion of the sigmoid was found. Bands apparently due to adhesions from diverticulitis. Male patient, fifty-one years. History of distention, obstipation and vomiting, acute in onset. Colostomy done at operation.

Fig. 19.—Diverticulitis of sigmoid.

This series of cases demonstrates that while the history is important and valuable in differential diagnosis, it may at times be misleading. Symptoms of short duration and of mild type may be found to be due to extensive lesions. Symptoms of the same type may in one case be due to an organic lesion of malignant character, and in another case to a purely functional disturbance. For example, the history in Fig. 16 is very similar to that of

Fig. 17, except that the latter contained more serious symptoms which were due, however, to purely functional disturbances. The less striking symptoms in Fig. 16, on the other hand, are due to carcinoma.

Physical examination is definitely diagnostic only when a tumor mass is found, and even in these cases, as illustrated by the cases demonstrated, laparotomy is frequently necessary for

Fig. 20.—Stricture of sigmoid due to fibrous bands.

absolute differentiation between appendix abscess, tuberculosis, fecolith, and carcinoma. The barium enema, carefully observed fluoroscopically, and repeated where the first observation is doubtful in results, is by far the most important laboratory measure, and is in most cases definitely diagnostic. It should be employed in all cases of abdominal symptoms not explained by other methods of diagnosis, and in all cases of unexplained anemia, loss of strength and weight.

NOTES ON CHOLECYSTOGRAPHY

SARA M. JORDAN

CHOLECYSTOGRAPHY by the Graham method has brought to the study of gall-bladder disease almost as much valuable help as the opaque meal to the study of diseases of the stomach and intestines. Its outstanding and most clear-cut advantages may be listed as follows:

1. The localization within or without the gall-bladder of calcium shadows in the region of the gall-bladder, where they must be identified as gall-stones and differentiated from calcified glands or renal calculi.

2. The visualization by negative shadows of the cholesterin stones within the gall-bladder—stones which, before the use of the dye concentration in the bile surrounding these stones, were never visualized.

3. The identification of dense areas which before the use of the Graham test were considered "pathologic gall-bladders." as shadows outside the filled gall-bladder; in other words, the extradition of the phantom pathologic gall-bladder.

The localization of calcium density within the filled gall-bladder can be made certain by films taken after inspiration and expiration, wherein gall-stones are seen to be contained within the filled gall-bladder in its varied positions. The renal calculi or calcified glands are found outside the gall-bladder shadow in at least one of these positions.

The visualization of cholesterin stones by the Graham test is a striking and important contribution to gall-bladder study. Here the difficulty in interpretation of mottling may sometimes be very great even to the trained observer, who acquires a kind of stereoscopic vision for the examination of these films. Overlying intestinal gas and a failure to obtain complete lack of mo-

tion of the patient, are the two technical difficulties which prevent accurate interpretation.

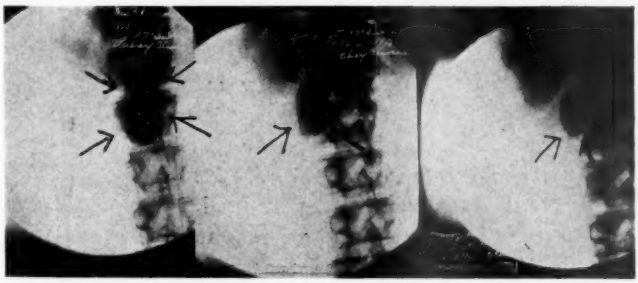
The so-called "density of pathologic gall-bladder," which in the days before the Graham test was often too eagerly accepted as valuable evidence, has been proved by the visualization of a normally functioning gall-bladder in another location, to be, in a large majority of cases, a phantom.

Fig. 21.—Long ptotic gall-bladder, fundus below the crest of the ileum, filled with cholesterin stones. This gall-bladder would not be visualized in the usual small film placed under the right hypochondriac region.

The other less standardized use of the test is the estimation of pathology by (1) the presence or absence of filling of the gall-bladder; (2) the rate of filling and emptying; (3) the density of the shadow; (4) the size and shape of the filled gall-bladder.

Standardization is desirable, but difficult in these phases of the test. The failure of the gall-bladder to fill is commonly found in pathology of the biliary tract, and frequently denotes obstruction in the ducts, but great care must be exercised in the

purely technical details of the test to differentiate between the non-visualized gall-bladder and the visualized gall-bladder in an unusual location. The very ptotic gall-bladder which lies at the level of the iliac crest is not seen in the usual small 8 x 10 gall-bladder film placed beneath the right hypochondriac region (Fig. 21). Furthermore, a filled gall-bladder which lies directly over the spine is identified only with great care, but after identification can be brought out into the hypochondriac region by manipulation of the patient with extension of the right arm and shoulder. It can be clearly seen and interpreted (Fig. 22).



A B C

Fig. 22.—A, Gall-bladder visualized faintly beneath the spine. B, Brought out by manipulation of the patient and seen to contain cholesterin stones. C, Same gall-bladder after contraction. Patient again manipulated with extension of arm to bring out gall-bladder from beneath spine.

The routine technic used in the Clinic consists of the intravenous administration of tetraiodophenolphthalein given in the late afternoon and followed fifteen to seventeen hours later (at 7.30 to 9.00 the following morning) by radiographic films. No supper is taken, and breakfast is not eaten until after the first films are taken.

In our experience, the rate of filling of the gall-bladder cannot be used as a diagnostic guide. It frequently occurs, in the case of the normal gall-bladder, that no visualization is obtained in sixteen hours, while a well-visualized gall-bladder is seen in a film taken one hour later. The question has arisen

whether sleep and activity have some effect upon the rate of filling. It has been observed that a contracted normal gall-bladder becomes dilated again six hours after a barium meal, as seen in Fig. 23.

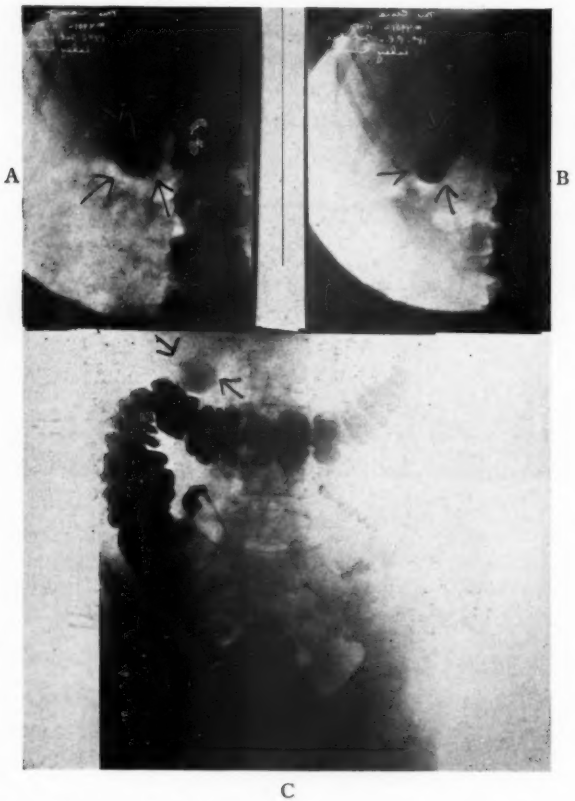


Fig. 23.—A and B, Gall-bladder before and after contraction. C, Six hours later, after a barium meal had been given, a less dense shadow is seen in the gall-bladder region of about the same size as the original dilated gall-bladder.

The presence of adhesions between gall-bladder and duodenum may be determined by films made after a barium meal.

The question of relief by cholecystectomy of symptoms due to gall-bladder adhesions can be determined only by further studies of end-results in gall-bladder surgery.

The normal gall-bladder may or may not be homogeneously filled. A well filled, dense fundus with a thin filling of the pelvis of the gall-bladder is, in our experience, seen in cases of normal gall-bladder (Fig. 24).

Non-filling of the gall-bladder has occurred, in our experience, with an acute exacerbation of duodenal ulcer or colitis, and after

Fig. 24.—A normal gall-bladder filled densely in the fundus with a thinner filling of the pelvis.

the subsidence of acute symptoms, with the same technic, the gall-bladder has filled and contracted normally.

The degree of contraction in one hour after a meal is, in our experience, unimportant, inasmuch as normal gall-bladders may empty completely or contract only to three-fourths their filled size. In colonic malfunction, a complete failure of the gall-bladder to contract after a meal has been followed several days later, after adequate bowel management, by normal contraction in an hour.

Fig. 25.—Normal pear-shaped gall-bladder.

Fig. 26.—Normal finger-shaped gall-bladder.

The shape and size of the gall-bladder vary as much as that of the stomach, and except when determined by adhesions, such variations denote no pathology. The normal shapes commonly seen are usually of three types:

The pear shaped (Fig. 25).

The finger shaped (Fig. 26).

The round shaped (Fig. 27).

The squared and blunted edges of the fundus are frequently due to adhesions. Moderate variations in size are certainly

Fig. 27.—Normal round gall-bladder.

normal, and it has been our experience that the abnormally large gall-bladder is usually not visualized for the same reason which causes the enlargement; namely, obstruction in the cystic duct.

Summary.—The Graham test administered intravenously has, in our experience, two definite, positive diagnostic values—the localization of calcium stones as within or without the gall-bladder, and the visualization of cholesterin stones. It also has one definite negative value—namely, the identification of the

gall-bladder as related or non-related to so-called gall-bladder density in the plain films.

The failure of the gall-bladder to fill and empty must, because of the presence of technical difficulties, be used with ex-

A B

Fig. 28.—Gall-bladder with diverticular formation at the tip of the fundus. A, Filled gall-bladder. B, Showing contraction after a meal. The diverticular portion of the gall-bladder contracts also.

treme care as a valuable diagnostic aid to clinical findings. This is also true to even a greater extent of abnormalities of size and shape, and rate of filling and emptying.

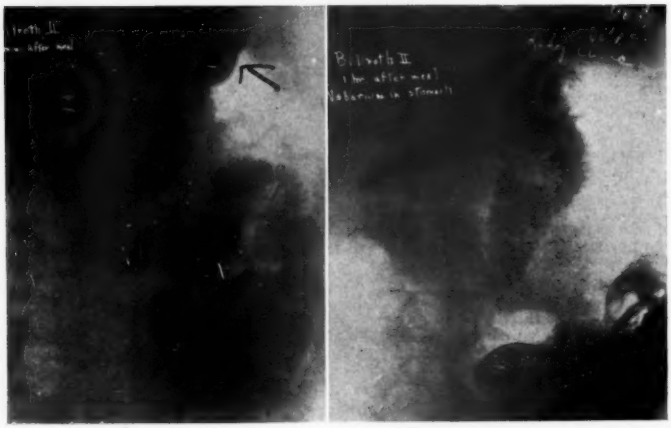
NOTE ON STOMACH RESECTION

SARA M. JORDAN

FROM the point of view of the gastro-enterologist who is concerned with postoperative care, resection of the stomach should not only remove the ulcer-bearing area, give adequate drainage, and reduce acidity. It should also provide the patient with as much comfort as this exceedingly unphysiologic procedure will allow. To accomplish the object generally acknowledged as the main object, namely—the removal of the ulcer-bearing area, the resection is often done with the removal of a large part of both greater and lesser curvatures, and the resulting stomach stump is in effect only a dilated portion of the esophagus through which food is passed quickly into the jejunum.

By this method, the totally undigested food material is first held for digestion in the dilated jejunum and this unphysiologic process is attended by symptoms of distention and distress. To obviate this difficulty without in any way jeopardizing the main object of resection, namely, the removal of the ulcer-bearing area of the stomach, a much more extensive portion of the greater curvature than of the lesser curvature may be left, and the resection done obliquely, thus producing a pouch-like stump which retains food material for partial digestion before it is passed on into the jejunum. The Hofmeister modification of the Polya operation and the Schumacher operation when executed with the saving of the greater curvature, both produce this result.

The accompanying illustrations show three resected stomachs. Fig. 29, the Billroth II operation, with the stump entirely empty in one hour. Figure 30, the antecolic Polya operation, also with no residue in one hour; whereas in Fig. 31, the Hofmeister modification of the Polya, about one-half of the meal is still being acted upon by the gastric mucosa in an hour. In these



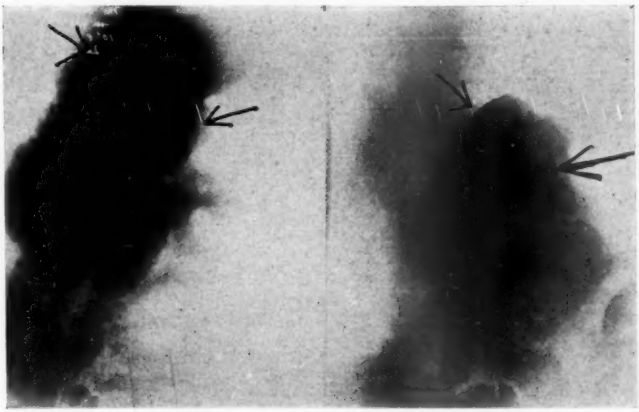
A B

Fig. 29.—A, Showing stump of stomach after Bilroth II operation. Barium emptying rapidly into the jejunum. B, One hour after the meal—no barium residue in the stomach.

A B

Fig. 30.—Showing stump of stomach after an antecolic Polya operation. A, Barium emptying rapidly from the stomach stump into the jejunum. B, One hour after a meal—no barium residue in the stomach.

3 cases, as in others observed by us, postoperative comfort appeared to be coincident with a delay in the stomach comparable to the physiologic delay in the normal stomach; whereas the rapid dumping from the stump into the jejunum produced definite



A B

Fig. 31.—Showing stump of stomach after a Hoímeister modification of the antecolic Polya operation, with a considerable part of the greater curvature of the stomach preserved. A, Stump of stomach emptying slowly. B, Considerable residue in the stump of stomach after one hour.

distress with distention, almost as troublesome as the symptoms for which operation is done. The stump which results when the greater curvature is spared, shows good peristalsis in spite of damage to the circular musculature and innervation, and often resembles a miniature stomach of normal contour.

AN ILLUSTRATIVE CASE OF SEVERE HYPERTHYROIDISM; ITS MANAGEMENT

ROBERT L. MASON

THIS case of primary hyperthyroidism (exophthalmic goiter) presents no strange or bizarre manifestations, but illustrates typically the various features of the disease and the problems presented in their management.

The patient is a single colored woman of forty-one, who has always made her home in Massachusetts. Until one year ago she considered herself well in every way. She then began to tire easily. Her friends noticed that her usual calm demeanor was replaced by one of irritability. She cried at the slightest reproof from her employer. She became conscious of her heart-beat. At first she thought this due to her work, but she later was conscious of the rapid pounding beat as she lay quietly in bed. She became sensitive to heat and was uncomfortably warm in a room in which others were quite comfortable. She perspired profusely. There was generalized pruritis. Her appetite was unusually good. She found it increasingly difficult to carry on with her work. Willing and anxious to work, she found herself so fatigued after a few hours that she was forced to stop. Especially noticeable was weakness of the knees. In going upstairs she frequently felt that her knees would give way beneath her. Her menstrual periods, usually lasting from four to five days, became progressively shortened to one day and the flow was scanty. Finally, three months ago she was forced to give up her position. She then began to have frequent attacks of diarrhea—eight to twelve watery movements daily. One month before coming to the Clinic, she began to lose weight and lost 15 pounds during this period. Two weeks later another attack of diarrhea began. During this attack she vomited several times daily.

We have here a fairly typical history of the development of primary hyperthyroidism. You will note that what are called the cardinal symptoms of exophthalmic goiter have not been conspicuous. Neither she nor her friends have noted any enlargement of the thyroid. There has been no exophthalmos. Although she has been nervous, tremor, as such, has not been a subjective symptom. Loss of weight did not occur until a month ago. But what have been called the "secondary symptoms" of exophthalmic goiter point clearly to the diagnosis. Time does not permit discussion of the subjective symptoms as they present themselves. Nearly all of them on investigation will be found to bear a direct relationship to the increased rate of energy exchange within the body. Loss of weight is usually more marked than in this case. The development of the gastro-intestinal disturbance, diarrhea, and vomiting point to intense toxicity.

Let us note the physical examination. During the taking of the history the patient was restless. She made constant purposeless movements, such as buttoning and unbuttoning her sweater. She continued this as preparations were made for the physical examination. Her attitude was that of over-eagerness. Her skin was moist and warm. She showed distinct evidence of loss of weight. There was no exophthalmos. However, if one watched closely, there was a definite fixed stare of the eyes, as if they were focused on an object at a distance. There was definite failure to converge. The teeth showed marked pyorrhea. The thyroid was enlarged to about one and a half times normal size, and had the firm elastic consistency of the hyperplastic gland. In addition, its shape was typical. By this we have especial reference to the well-defined and firm upper poles. There was a definite bruit, but to this we do not attach especial significance. The heart was not enlarged. The sounds were weak and rapid (150), the rate regular. There was a fine tremor of the extended fingers, and of the extended foot. This tremor was generalized. If one placed his hand on the upper arm while eliciting the tremor of the fingers, the whole arm was felt to be trembling. When seated well forward on the chair, she was asked to extend her leg outward from the hip. She was able to lift the leg to this position,

but was unable to keep it extended. This test of quadriceps function, described by Dr. Lahey, has been very valuable as an index of toxicity. A normal person is able to extend his leg in the manner described for over a minute; the thyrotoxic individual rarely over forty seconds—usually between twenty and thirty seconds.

There is, of course, no doubt as to the diagnosis. The important thing now is the evaluation of the patient's condition and her ability to withstand surgery. What preparation will she need? Will a multiple stage procedure be necessary?

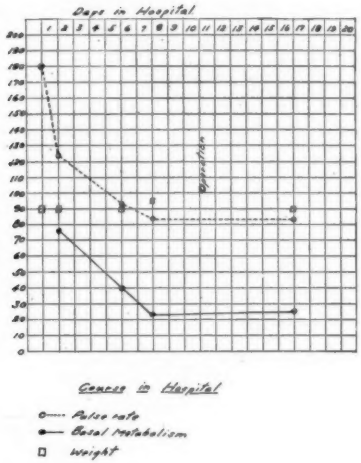
One would naturally think that this last question could be settled best after the preliminary rest period and at the time of operation. We have found by experience, however, that the marked improvement noted after preliminary rest and medication can be most deceptive and, if used as an index of the patient's ability to withstand operation, may result in most unfortunate sequelæ. One week's or several weeks' rest and iodin medication cannot wipe out the effect of months' or years' toxicity. Each patient must be an individual problem, and their condition *at the time of their first examination* gives us the best criteria upon which to base their subsequent treatment. So then, it is most important to commit one's opinion as to operability when the patient is first seen. Long duration of toxicity, cardiac damage, impairment of renal function, marked loss of weight, severe asthenia, gastro-intestinal crises—all point to danger and demand conservatism. For instance, let us consider this patient. She has a marked degree of asthenia as shown subjectively by her inability to do any but the lightest task without exhaustion. Objectively, the asthenia is well shown by the quadriceps test. She has a pulse of 150. She has lost 15 pounds in the past month. She has had persistent vomiting and diarrhea—manifestations of intense toxicity. These considerations show her to be a severe case of hyperthyroidism and a note is inscribed on her history to the effect that two operations will probably be necessary.

The patient entered the hospital on the same day on which she was seen in the Clinic. The excitement incident to the trip to the Clinic and the examination had apparently augmented

the toxicity. When seen on the evening visit at the hospital she had a pulse of 180. She was extremely restless and irritable, threshing about the bed constantly. She had vomited several times, and there had been a number of watery bowel movements. She appeared slightly irrational. Her breath was acidotic. She was obviously on the verge of a thyroid crisis or so-called thyroid storm.

She was given $\frac{1}{4}$ grain of morphin subcutaneously, and an intravenous infusion of 750 c.c. of normal saline in which were

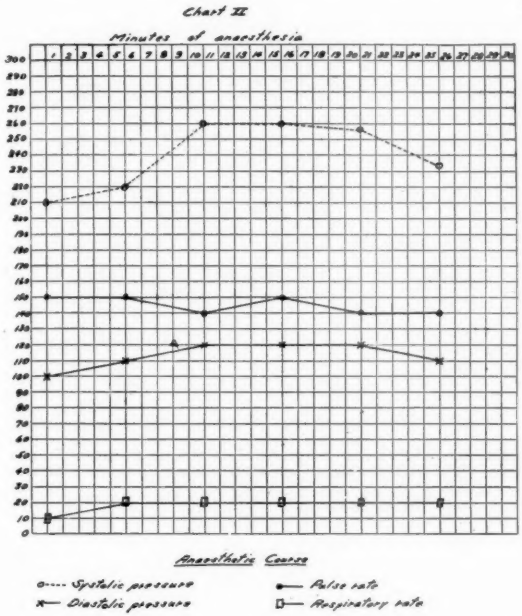
Chart I



contained 50 grams of glucose. Following the intravenous infusion she appeared much improved. She was no longer nauseated and was quieter. Lugol's solution in 20 minim doses was then started and during the night five doses were given. These she tolerated well and did not vomit. The intravenous infusion was repeated the next morning, and during the day 50 minims of Lugol's solution were given in 10 minim doses; 3 teaspoonfuls of lactose were added to drinks whenever possible. She was encouraged to eat. Morphin was given in $\frac{1}{4}$-grain doses sufficiently often to allay the slightest restlessness. On the second morning

a basal metabolism estimation showed a rate of +78. The iodin was now reduced to 10 minims three times daily. Morphin was stopped. Luminal, $\frac{3}{4}$ grain was given night and morning. Fluids were forced to at least 3000 c. c. daily. She was kept in bed except for half-hour periods in the morning and afternoon, when she was allowed to be up and about.

Chart I shows the improvement in her condition during the subsequent eight days. On September 24th, ten days after en-



trance to the hospital, it seemed that the maximum clinical improvement had been reached and that she was ready for operation. The basal metabolic rate was now 24, the pulse rate 84. The maximum improvement with rest and iodin occurs fairly constantly between the eighth and tenth day. Beyond this period there occurs a gradual return to the condition before the treatment is instituted. Herein lies the importance of emphasizing

that iodin in exophthalmic goiter be given as a preoperative measure only. An important factor in this patient's improvement is that she had had no iodin therapy before coming to the hospital. Iodin improvement, once achieved, seldom can be repeated with the same efficacy.

Clinically we have seen this patient improve in a most satisfactory manner during her preoperative régime. However, the crucial test is now at hand. How will she react to the operation which we believe will complete and make permanent the improvement which has begun under the preoperative régime? She is brought to the operating room in a semi-somnolent state induced by two subcutaneous injections of morphin ($\frac{1}{6}$ grain) and scopolamin (1/200 grain); one given two hours and the other one hour before. She is entirely passive as she is moved from the carrier to the operating table. Prepared and draped, ethylene anesthesia is begun. Dr. Sise, our anesthetist, records her pulse as 150, her blood-pressure 210/100. In three minutes she is ready for the initial incision. As we make the incision, we ask her condition. Has the pulse rate risen? What is her pulse pressure? Dr. Sise tells us that her pulse rate of 150 has been maintained during the initial anesthesia. Her pulse pressure, however, has risen 10 points. Dr. Sise, at the head of the table, with accurate and frequent determinations of pulse rate and pulse pressure, is now the best informed as to her present condition and her ability to withstand the operation. In his opinion, considering the preoperative prophecy of two operations coupled with the pulse rate of 150, which shows a tendency to rise, and a pulse pressure of 120, we should conduct the operation in such a manner that we may stop after a subtotal hemithyroidectomy is done, if there is no improvement in her condition. By being able to stop we mean that we have exposed but one lobe, and when this portion of the operation is finished, and the patient has not done well, the neck can be closed easily with the other lobe untouched.

The subtotal hemithyroidectomy on the right side is now nearly finished, and we again ask Dr. Sise for a report of the patient's condition. Since we started, twenty minutes ago, her

pulse rate has remained at 150. Her pulse pressure has slowly risen to 140 (systolic 260, diastolic 120). Should we continue and do a bilateral thyroidectomy? We review the patient's history; we bear in mind our impression when we first saw her. These factors together with the course on the table point clearly to the advisability of a conservative operation. The incision is closed.

We have never had cause to regret doing the conservative operation on a patient who has shown the findings brought out in the above discussion. This is the type of patient whose good condition during the preparation period has been deceptive and who, on having a complete operation, develops a full-fledged reaction and dies.

This patient, after a six weeks' interval, will have improved so much that the second stage of the operation may be undertaken without the slightest hesitancy.

Further Notes.—During the subsequent forty-eight hours the patient had a moderately severe postoperative reaction; enough of a reaction to make us glad that the conservative measure was adopted. With the administration of frequent infusions of intravenous glucose, large and frequent doses of morphin, and continuation of the iodin therapy started before operation, the reaction had entirely subsided by forty-eight hours. Her remaining four days in the hospital were uneventful. Her basal metabolism six days after operation was +16. She was given a prescription for Lugol's solution 10 drops daily, and asked to report in six weeks for completion of the operation. In a series of 100 cases, with weekly estimations of the basal metabolic rate, we found that the maximum improvement following subtotal hemithyroidectomy comes about the sixth week. Subsequently the basal rate rises and symptoms of increased toxicity become evident.

AN AIR CUSHION FOR CHOLECYSTECTOMY

ROBERT L. MASON

THAT the exposure in operations on the biliary tract may be improved by the insertion of a support beneath the back, in the

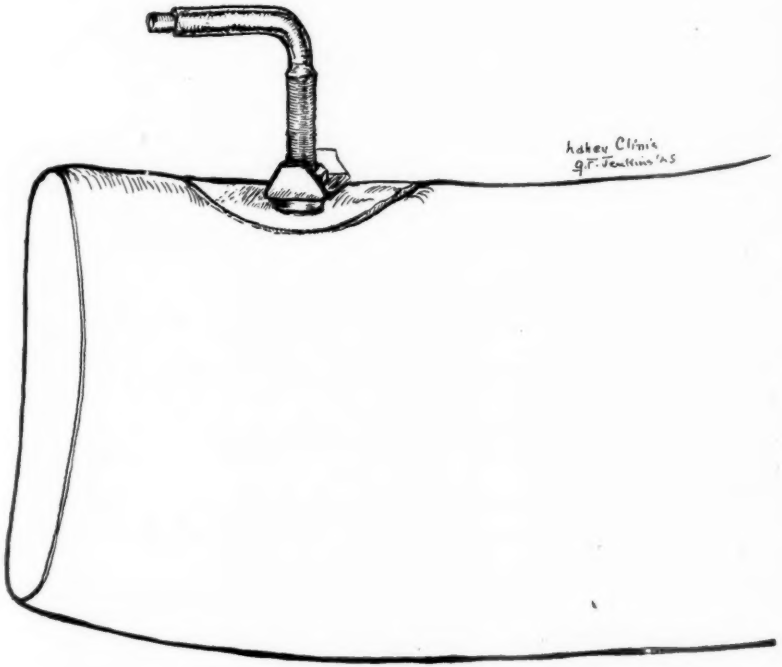


Fig. 32.—Section of balloon tire.

lower thoracic region, is well known. Properly placed, such a support elevates the liver and biliary tract and allows the in-

testines to fall forward, away from the field of operation. By slight traction on the gall-bladder, with such preliminary elevation, the region of the ducts may be brought well up toward the surface of the wound.

Sand-bags have been used for this purpose, but have the disadvantage of being inserted and removed with difficulty. If

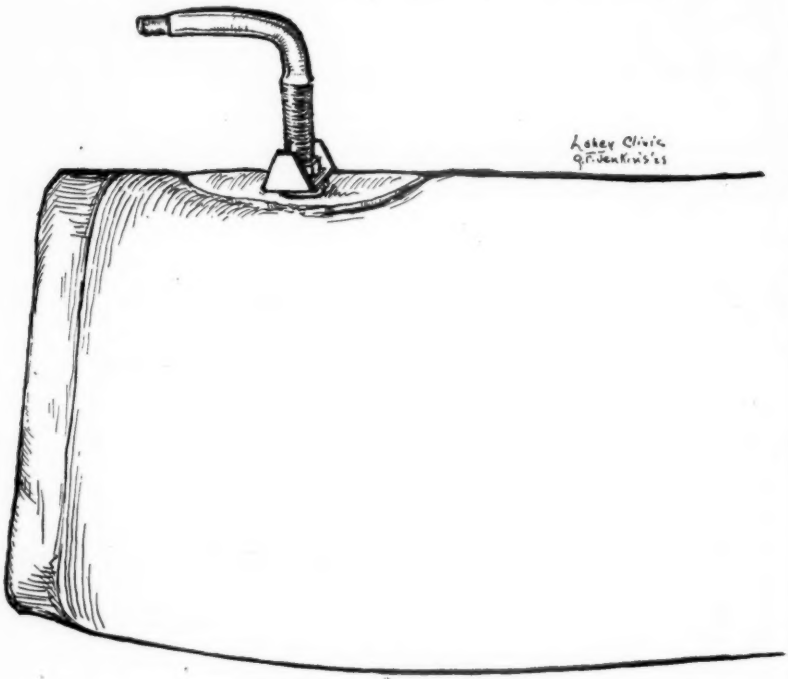


Fig. 33.—End of tire vulcanized.

inserted before the anesthetic is begun there is considerable discomfort during the induction. To insert it afterward is difficult. A support which may be easily inserted or removed is of distinct advantage. By this means the operative field may be elevated when the patient is ready for the initial incision and lowered when the wound is ready for closure. Adjustable bars

on the operating table may serve this purpose, but severe post-operative backache invariably follows their use.

A deflatable air-bag as devised some years ago by Rutherford Morrison is a very satisfactory support. We have had difficulty in securing a serviceable bag of this sort on the market, and have,

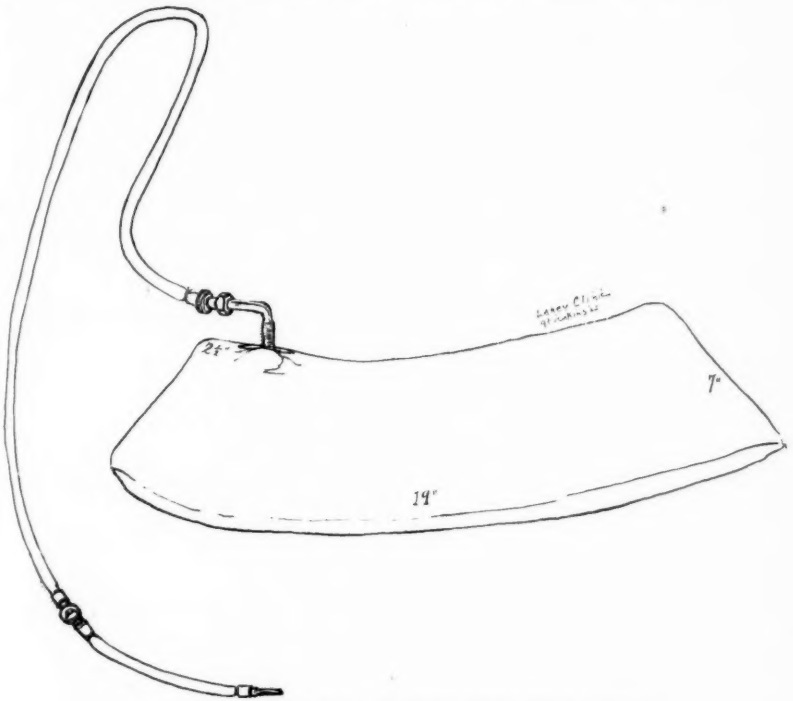


Fig. 34.—Bag completed with rubber tubing fitted to valve.

therefore, devised one in the following manner. In preparing this paper for publication, we find that Dr. Herbert H. Judd, in 1924 described a similar device in the Journal of the American Medical Association.[1]

A section of a 5-inch balloon tire inner tube, 19 inches in length, was cut in such a way that it included the valve 2 inches

[1] Jour. Amer. Med. Assoc., 1924, 82, 1199.

from one of its ends (Fig. 32). The open ends of the rubber tube thus obtained were vulcanized (Fig. 33). Over the whole was

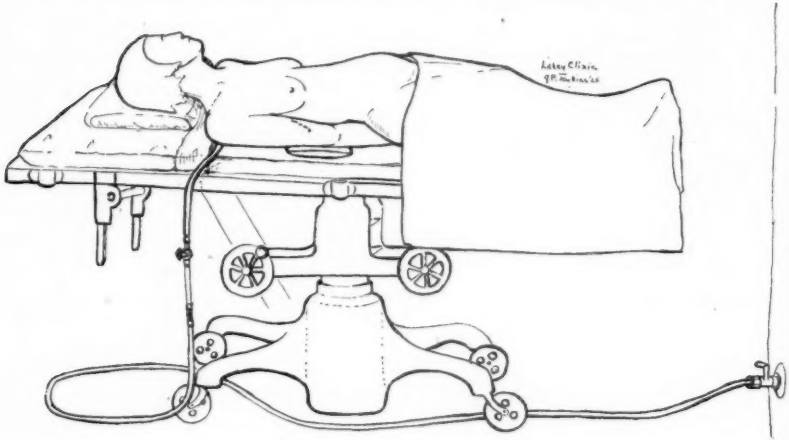


Fig. 35.—Bag in place ready for inflation.

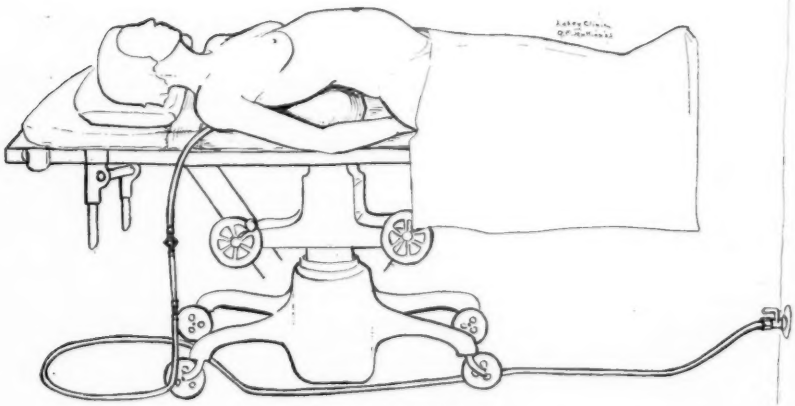


Fig. 36.—Bag inflated.

sewed a heavy canvas cover. A rubber tube with a detachable connection and a valve completed the apparatus (Fig. 34).

The bag may be inflated, when in position and when needed, by positive air pressure. In this Clinic we inflate the bag by positive air pressure, piped to the operative room, which furnishes 15 pounds pressure. Another means of inflation is to connect the intake tube of the bag with the nitrous oxid or oxygen tank, the pressure from which is sufficient to inflate the bag.

THE RADICAL OPERATION FOR CARCINOMA OF THE BREAST

ROBERT L. MASON

THE principles of the radical operation for carcinoma of the breast as described by Halstead and Willy Meyer are so well founded and productive of such good results that the fundamentals of the operation have not been materially altered since their presentation. Technic alone has varied. The basic principles require excision of the breast with a wide margin of tissue together with the removal of both pectorals and the dissection of the axilla.

The operation itself, based on anatomic principles, is carried out by careful dissection. Unless one has a fairly definite and systematic approach to the involved structures, the dissection tends to be rather long drawn out. For some years Dr. F. H. Lahey has carried out the dissection by a series of steps which clearly delineate the anatomy and serve to facilitate the whole procedure.

Briefly, these steps are as follows:

1. **Incision.**—The incision is an elliptic one, encircling the breast with a wide margin (Fig. 37). The only detail in which it differs from the usual elliptic incision is that it does not follow the lower border of the pectoralis major muscle and extend down the arm. It begins, rather, at the midportion of the deltoid with the arm abducted, and descends downward in the direction of the fibers of the pectoralis major. In this way one avoids, in the healed incision, the thick band of scar tissue stretching across the anterior border of the axilla, as is usually seen in cases in which the incision has been made with an extension downward on the arm.

2. **Identification of Cephalic Vein.**—The dissection begins with the identification of the cephalic vein. This vein not only serves to distinguish easily the dividing line between the deltoid and pectoralis major muscles, but its preservation is important

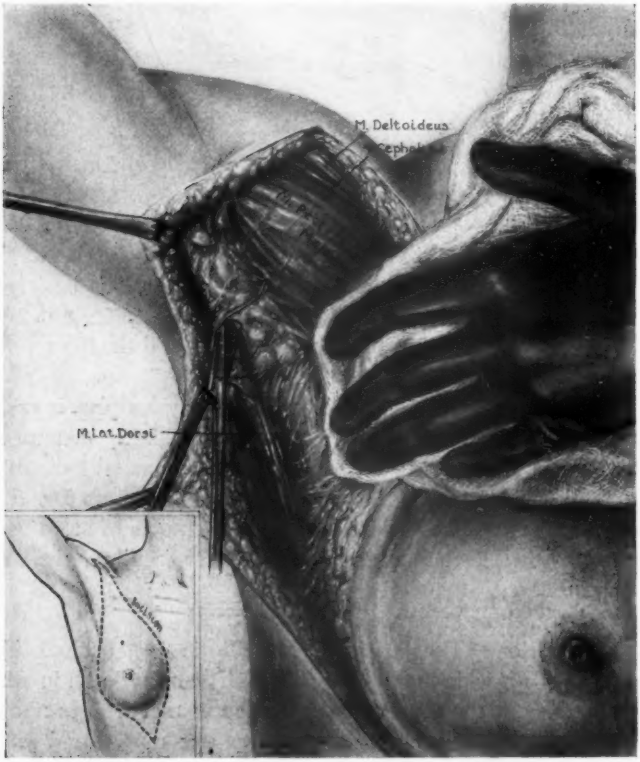


Fig. 37.—Cephalic vein has been identified. Latissimus dorsi being exposed. Insert shows line of incision.

should the axillary vein be injured or found extensively involved in a metastatic process. Once identified, the vein, together with the upper border of the pectoralis major, is exposed from the outer margin of the incision inward for about 2 inches (Fig. 37).

3. **Exposure of Latissimus Dorsi.**—The latissimus dorsi muscle and the pectoralis major muscle, when followed toward their insertion, tend to form a triangle, through the apex of which, and separating the two muscles, runs the coracobrachialis

Fig. 38.—Section of pectoralis major. Actually the point of severance should be closer to the humerus.

muscle with the axillary vessels just below its lower border. The next step, then, is to expose the latissimus dorsi muscle well down along the lateral edge of the incision, and to follow its outer border upward to the pectoralis major. This done, the axillary

vein is easily identified in the fat which fills the apex of the triangle formed by the latissimus dorsi and pectoralis major muscles. The inner two-thirds of the vein is overlaid by the pectoral muscle.

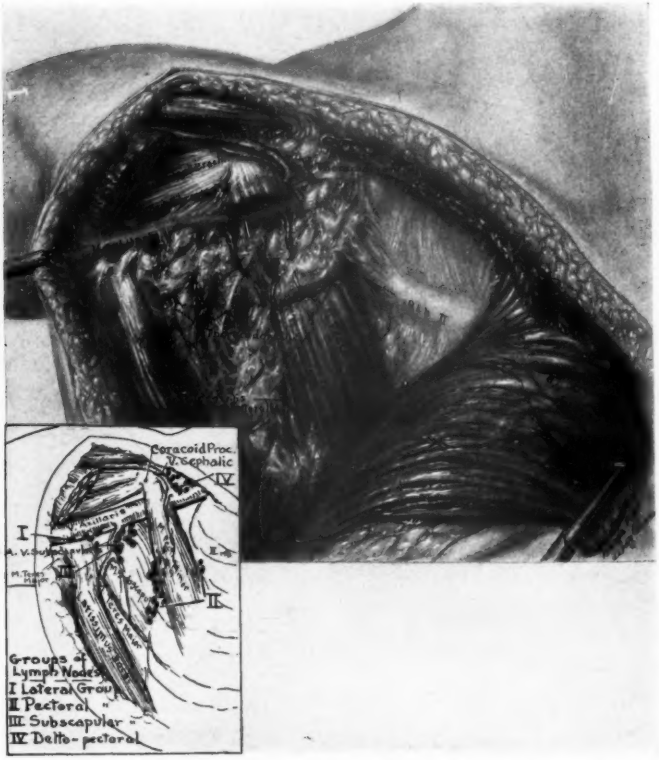


Fig. 39.—Pectoralis major has been reflected inward. Pectoralis minor has been severed. but not reflected. Axilla ready for dissection. Insert shows location of various lymphatic groups.

4. **Division of Pectoral Muscles.**—To further expose the axilla, the index finger of the left hand is inserted beneath the pectoralis major up to the deltoid, using the cephalic vein as a guide. The muscle is now sectioned well toward its insertion into

the humerus, and turned inward (Fig. 38). The innermost portion of the vein is still covered by the pectoralis minor as it goes toward its insertion into the coracoid process. This muscle is now severed close to its insertion, care being taken to avoid injury to the acromiothoracic vessels which extend along its upper border. In some instances it will be necessary to divide these vessels. The muscle, now divided, is turned inward, and the whole axilla is well exposed.

5. **Dissection of the Axilla.**—By sharp dissection, the fatty tissue which extends along the vein is divided and turned downward. As far as possible, in the dissection of the axilla, the axillary fat is removed and retracted downward and inward as one piece. Figure 39 shows the location of the important lymphatic groups. As the fat is reflected downward from the vein, particular care is directed toward the thoracodorsal vessels. The thoracodorsal nerve (O. T. long subscapular) is the chief nerve-supply to the latissimus dorsi muscle, an important adductor, retractor, and medial rotator of the upper arm. Its preservation is to be desired *if the region of the subscapular vessels is not obviously involved by metastatic glands*. If so, the vessels and nerve should be sacrificed unhesitatingly. If, however, there are no palpable glands in this region, we believe it is safe to dissect carefully and clearly the vessels from their surrounding fat. This done, the axilla is cleared of all fat, leaving the axillary vein and artery bare of their covering and exposing well the fascial surfaces of the teres major, teres minor, latissimus dorsi, and serratus anterior muscles. Care should be taken to preserve the important long thoracic nerve as it passes downward on the lateral surface of the serratus anterior.

6. **Removal of Breast with Attached Tissues.**—The breast, together with the severed pectoral muscles and the dissected axillary fat is now pulled upward, putting the pectoral muscles on tension and the whole mass reflected inward to the midline, along which the muscles are divided. The dissection is carried well downward to involve a small segment of the uppermost portion of the rectus fascia.

7. **Drainage.**—A small slip of rubber dam is now placed to

the infraclavicular space and brought out through a stab wound well down along the midaxillary line. The wound is now ready for closure. If necessary, the medial border of the incision is undercut somewhat, to allow greater mobility. Most wounds can be closed satisfactorily. If tension is such, however, that the wound cannot be brought together without obviously jeopardiz-

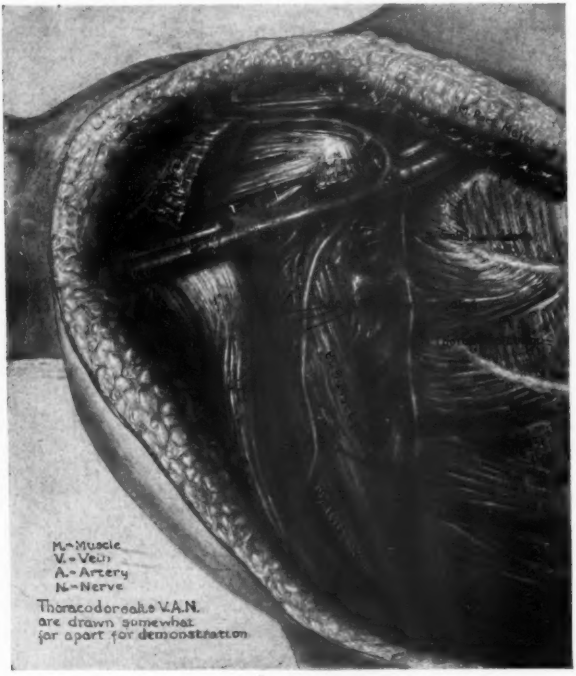


Fig. 40.—Dissection completed.

ing the skin edges, the defect is covered with Thiersch grafts. This is rarely necessary.

8. **Dressing.**—An important detail in applying the dressing is the placing of a sizeable pad in the infraclavicular space. This pad is secured by a wide band of adhesive before the remainder of the dressing is applied.

9. **Postoperative Care.**—The drain is removed after forty-eight hours, leaving the infraclavicular pad in place for removal after another forty-eight hours. The patient is encouraged to move the arm after forty-eight hours. These movements of the arm should be so graded that on the fifth day the patient should be able to abduct the arm fully. Internal rotation should be encouraged. The patient may get out of bed on the fifth day. Alternate superficial stitches are removed on the seventh day; the remainder on the tenth. The deep stay sutures are removed on the twelfth day.

THE USE OF QUINIDIN SULPHATE IN AURICULAR FIBRILLATION

LEWIS M. HURXTHAL

AURICULAR fibrillation is frequently found in patients with hyperthyroidism. Clinically, there are two types: One established fibrillation, often relieved by thyroidectomy; and paroxysmal fibrillation occurring frequently before operation, and often following removal of thyroid tissue. Occasionally, the latter type follows as the result of other major operations, particularly if there is an antecedent history of attacks of irregular palpitation.

There is little doubt that it is better to have normal rhythm than this irregularity. Although the rapid type may be controlled by digitalis and often without discomfort to the patient, nevertheless a great number, in spite of reassurrance, are annoyed by its presence and not a little worried. If the use of digitalis can be avoided and normal rhythm restored, we feel the patient is less apt to develop a cardiac neurosis. It may also be argued that the heart is more efficient under normal rhythm even though the rate has been controlled.

In those patients with hyperthyroidism where auricular fibrillation has become established, thyroidectomy will restore normal heart rhythm in 50 to 60 per cent. of cases. In our experience, the remainder of this group usually can be restored to regular rhythm by the use of quinidin sulphate. Paroxysmal auricular fibrillation will yield to full doses of digitalis or quinidin, but it is unusual to find digitalis effective in established auricular fibrillation when thyroidectomy alone has not brought about normal rhythm.

It is often difficult to decide whether fibrillation has stopped by itself or as the result of cardiac medication. In order to judge the efficacy of various procedures we, in this Clinic, have

recently divided all cases of established auricular fibrillation in hyperthyroidism into two groups. In one group we have administered digitalis routinely before operation, and in the other we have disregarded the presence of auricular fibrillation, except in those patients with congestive heart-failure who failed to regain adequate compensation to withstand operation. Although the results of this study are not to be discussed here, it is mentioned because one-half of the patients in whom normal rhythm was restored by quinidin were still under the influence, at least partially, of digitalis. We are as yet unprepared to say whether we believe quinidin therapy is enhanced or retarded by digitalization.

We have further divided all cases of postoperative auricular fibrillation into two groups, one receiving no medication until three days after onset unless normal rhythm has re-established itself without drugs, the other group receiving alternately full doses of digitalis or quinidin. In the groups of established fibrillation, no attempt has been made to restore normal rhythm until three days after operation. While this does not exclude absolutely the effect of removal of thyroid toxicity by thyroidectomy, nevertheless we feel it reduces that effect to a minimum. Since the average stay in the hospital following thyroidectomy is only seven days, a longer period of observation is impossible. As a preliminary report, our results seem to indicate that in about 75 per cent. or more it can be conservatively assumed that cardiac medication has been effective.

There are a few cases which have not been included in this study. These cases were especially selected as contraindicating the use of quinidin. We feel that there is little danger of embolus in the majority of patients following restoration to normal rhythm. As over 50 per cent. stop fibrillating as the result of operation without emboli, we do not fear it in the remainder. It is true that when auricular fibrillation is associated with congestive heart-failure in thyrotoxic patients, thyroidectomy does not usually bring about normal breathing. If it did, perhaps we would see more cases of emboli. It is this type of case in which we proceed cautiously in deciding upon quinidin therapy. If we find a very

large heart in a patient with marked congestive heart-failure, who, by the usual clinical methods of observing the force of the heart-beat, is shown to have rather feeble contractions, we exclude them from those eligible for quinidin therapy. Dilated hearts, especially those associated with valvular disease, favor thrombosis. On the other hand, we not infrequently see an over-active heart with varying degrees of congestive failure. They are the ones most benefited by removal of thyroid toxicity. In this group we believe there is little chance for thrombosis formation and have administered quinidin successfully without accident. The latter belief is borne out by clinical experience, in view of the negligible number of cases of embolism following thyroidectomy. We have paid little attention to the duration of fibrillation as a criterion for the use of quinidin. We have restored normal rhythm in patients previously discharged with auricular fibrillation who have returned for observation from three months to two years after operation. These patients, it might be added, were suffering from little, if any, cardiac disability except the annoyance of irregular palpitation.

Quinidin is much less effective in valvular heart disease. But should a thyrotoxic patient have this type of heart disease with auricular fibrillation, the effectiveness of quinidin, as one would expect, is more pronounced. They will yield to quinidin in greater numbers than when hyperthyroidism is not present. Thyroidectomy, on the other hand, seems less effective in restoring normal rhythm in this clinical combination.

In a number of cases of auricular fibrillation without thyroid disease, we have found quinidin to be always effective in the arteriosclerotic and hypertensive heart without congestive failure, or in those patients in whom no definite evidence of heart disease is present. In those patients with marked congestive failure or in those who are on the verge of it, we have not attempted to produce a return to regularity, digitalis having been urgently needed in most cases. In rheumatic heart disease with valvular defects, quinidin has been effective in less than half of the cases. We have not increased the dosage of the drug beyond 50 to 60 grains in twenty-four hours, which may account for our failure

in some cases. Again certain cases with this type of heart disease were not given a trial with quinidin. We have avoided it in those showing marked mitral stenosis along with signs of chronic passive congestion. As in the thyroid group we have not emphasized the duration of the irregularity. If the fear of embolus on restoration of normal rhythm is to be entertained, we feel the important criterion by which a case may safely be given quinidin is the absence of those pathologic-physiologic conditions, in ad-

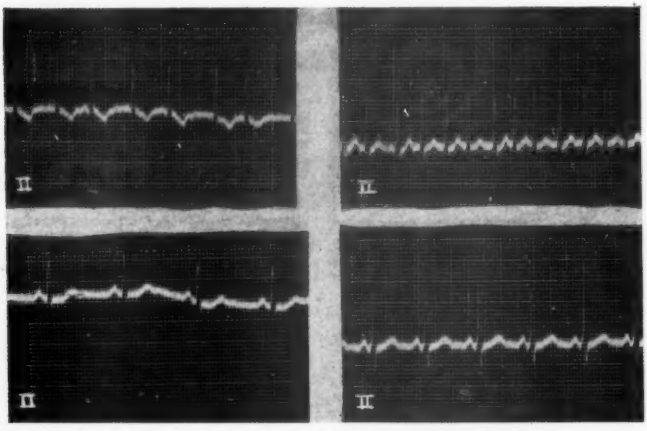


Fig. 41.—Upper left: Hyperthyroidism—established auricular fibrillation. Thyroidectomy in two stages. Patient digitalized. Lower left: Same case—normal rhythm after 27 grains of quinidin on fourth day after second operation. Upper right: Hyperthyroidism—postoperative auricular fibrillation, ventricular rate 210, duration seventy-two hours. Lower right: Same case after 22 grains quinidin, normal rhythm.

dition to fibrillation itself, which are most favorable to thrombus formation.

Our technic of administration has been to give a test dose of 3 grains by mouth in the morning and, if no reaction takes place after two hours, and to date we have had none, 6 grains are given every hour until some sort of subjective or objective disturbance is noted either by the patient or nurse. In case the latter does not happen it is continued until the pulse becomes regular or until a total of 39 grains have been given. In a few cases we have

exceeded this dosage when the desired result has not been produced. When normal rhythm has been established, it has been customary to continue giving 3 grains twice a day during the patient's stay in the hospital. If the thyroidectomy is done in two stages, the patient continues taking 6 grains daily until he returns in six weeks for the final operation. In cases where fibrillation has recurred within a day or so, we have again employed the hourly dosage, and then, with normal rhythm reestablished, we have given on the following day 3 grains less than the amount which was needed to restore regularity. We have been able to prevent recurrence by decreasing the dose each day by 3 grains until the patient receives only 6 grains daily. Some are discharged on a ration of 6 grains, while others have left the hospital without it.

All cases in which quinidin has been used successfully, and who have returned for observation at periods from three to six months, have been found to have maintained normal rhythm. In over 100 patients in whom quinidin has been used we have had no alarming symptoms except in one instance. This patient recovered and a description of the case is about to be reported.

We have, therefore, found quinidin sulphate a valuable drug in the restoration of normal heart rhythm. Established auricular fibrillation has been stopped in the majority of cases when thyroidectomy had failed to do so, from three days to two years after operation. Quinidin therapy in our hands has been effective in all cases of postoperative paroxysmal fibrillation, whether in thyroid patients or not. Half of this group were given quinidin at onset. The remainder, if fibrillation has not ceased in the interim, were given the drug three days after onset.

In established auricular fibrillation in non-thyroid patients, quinidin has restored normal rhythm in all cases not showing valvular disease, marked cardiac disability, or congestive heart-failure. Of the latter exceptions, quinidin was effective in less than 50 per cent. of the valvular cases, and was not tried in those in which we had reason to believe auricular thrombi might be present.

THE USE OF POSTURAL DRAINAGE IN POST-OPERATIVE PULMONARY COMPLICATIONS

LEWIS M. HURXTHAL

POSTURAL drainage of the trachea, bronchi, or lung cavities is a simple but effective clinical procedure. Its value in lung abscess and bronchiectasis has been well recognized and its use has become extensive. Recently we have employed this method with apparent success following laparotomy on patients who appeared to be literally drowning in their own mucus.

In elderly people following anesthetics the development of what is often considered bronchopneumonia is not uncommon. Recent authors have shown that often these complications are really collapse of part or all of one lobe or lung, due in their opinion to bronchial occlusion from mucus. Keeping the air passages free from secretion is, therefore, an important preventive procedure.

When the cough reflex has been abolished by morphin, or all attempts to raise sputum are suppressed by the patient for fear of pain, bronchial secretions readily accumulate. In some of our patients this has happened to an alarming degree in a very short time after operation. The appearance of dyspnea, varying degrees of cyanosis, and the tracheal rattle produce a rather distressing picture.

In the cases in which we have tried postural drainage, the results have occasionally been so dramatic as to convince us of the effectiveness of this procedure. Below is given the important facts in two typical cases.

A man of sixty-two years of age developed moderate cyanosis, rapid breathing, and tracheal râles twenty-four hours after cholecystectomy. Physical examination of the lungs revealed no areas of dulness or flatness, breath sounds came through nor-

mally, and, of course, tracheal and bronchial rattling was heard throughout. The blood-pressure was 150/90, approximately the same as before operation. The pulse was 112. Respirations, 36. Temperature, 101° F. The patient was unable to raise sputum. His head and shoulders were gradually let down lower than his trunk. The patient began coughing and soon raised considerable mucus. After being in this position about five minutes he was returned to the upright position, his color having improved remarkably along with easier breathing and a much better mental state. He recovered without further incident, and was discharged well.

Another patient, an obese man of sixty-four years, developed fever, slight cough, and a mild degree of cyanosis within twenty-four hours following laparotomy for acute, gangrenous appendicitis. Tracheal râles were audible without the stethoscope. He purposely suppressed his cough because of abdominal pain. Examination of the lungs revealed no evidence of collapse or consolidation. When seen, he appeared toxic, with beads of perspiration on his forehead. His temperature was 100.5° F. Pulse, 100. Respiration, 25.

His bubbling breathing could be heard across the room. This patient was likewise tipped head down and, after tightening the abdominal binder, he was encouraged to cough. This he did and raised in a few attempts about 2 or 3 ounces of mucopurulent sputum of a tenacious character. The audible râles disappeared almost immediately. He was treated in this manner several times at three-hour intervals until there was no longer a tendency for mucus to collect. By this time his temperature had become normal. He recovered without further incident.

We have used this procedure with less dramatic, but with equally beneficial results in several cases of definite postoperative bronchopneumonia. Usually the patients were rather feeble, lacking strength to cough with sufficient force to raise sputum. Postural drainage two or three times a day has enabled them to clear out the upper air passages, and relieved them of a constant desire to cough.

Our plan has been to place the patient on his side without

pillows, and to raise the bed so that the buttocks are about 30 degrees higher than the patient's head. With modern hospital beds this is very easily accomplished. The change is done slowly, in order to allow the patient to become gradually accustomed to his new position. Pressure in the pulmonary vessels is thus greatly increased and an extra load is thrown upon the heart. Too sudden a change should, therefore, not be made, and is not without danger, particularly on enfeebled patients. When an elevation has been reached which the patient feels he can fairly comfortably tolerate for a few minutes, he is encouraged to cough. Occasionally coughing begins involuntarily, due probably to the increased pulmonary pressure mentioned above.

As a rule three to five minutes is long enough for this type of patient, as most of the secretion is in the upper air passages. It can be repeated, however, as often as desirable. If necessary to continue more than a day, the length of each draining period may be increased.

We feel, therefore, that we have obtained immediate beneficial results and possibly have prevented more serious pulmonary complications by postural drainage. If this procedure were to be carried out at the earliest evidence of tracheal râles, certainly a step in the right direction will have been taken against the prevention of some postoperative pulmonary conditions.

ELEPHANTIASIS—KONDOLEON OPERATION

HOWARD M. CLUTE

CASES of elephantiasis in which no satisfactory etiologic factor can be discovered are occasionally encountered. The case report given here records such a patient treated by the Kondoleon operation with satisfactory immediate results.

Mrs. G. L. is a married woman twenty-six years of age. With the exception of rheumatic fever when a child, she has had no previous illness. Her tonsils and adenoids were removed when a child.

Slightly more than seven years ago she noted that her left ankle and lower leg were swollen. This swelling increased in amount, and gradually extended upward to involve the whole lower leg and the knee. There has never been any pain in the extremity, but there has been a constant feeling of weight and a dull ache and sense of discomfort. There was no history of any preceding injury or infection in the leg or pelvis.

Five years ago the patient married. She has had 4 pregnancies, one of which terminated in a miscarriage while the other three children were normal, and she now has three children who are healthy in every way.

Before coming to the Clinic, various measures to reduce the size of the leg had been employed without benefit. These have included many weeks in bed, tight bandages, elastic stockings, massage, electricity, diet, etc.

Examination of this patient revealed no evidence of any pathology elsewhere than in the left lower leg. The left leg showed a marked general enlargement from ankle-joint to just above the knee. The skin was coarse, thickened, and noticeably dry and scaly. Slight pitting occurred on pressure. Some cyanosis and mottling were present when the patient stood for

a few minutes. Measurements of the circumference of the right and left legs at different levels showed the left leg to be 2½ inches larger at the ankle, 4 inches larger at the calf, and 2½ inches larger at the knee. There was no difference in the measurements of the thighs.

Blood examinations were negative.

A diagnosis of elephantiasis of unknown etiology (idiopathic type) was made, and operation recommended. The entire left

Fig. 42.—Elephantiasis: Before operation.

leg from groin to toes was thoroughly prepared for operation by shaving, and then a sterile scrub and dressing was applied daily for two days. The technic of the operation followed that recommended by Dr. Sistrunk of the Mayo Clinic.

Under ethylene-oxygen anesthesia two elliptic incisions were made from the lower third of the thigh down to the external malleolus. These incisions were so placed that they included

but a small amount of skin at the knee-joint; slightly more above it, and over the middle of the lower leg and the ankle, they included about 1 inch of the skin before they came together at the external malleolus. The incisions were made about $\frac{1}{4}$ inch deep or less, and the knife was now made to undercut the skin for nearly 2 inches on the outer side of each incision. At this point the incision was carried down through the greatly thickened and edematous fatty and fibrous tissue to the fascia, and the entire

Fig. 43.—Elephantiasis: After operation.

long flap containing skin and fat removed. We found it technically easier not to attempt to remove a fascial strip until this wedge-shaped piece of skin and fat were out of the field. We next removed a strip of deep fascia about 2 inches wide from the entire length of the base of the wound. At this stage, then, the edges of the wound are seen to be definitely undercut because a long strip of skin perhaps 1 inch wide, a strip of fat perhaps 4 inches wide, and of fascia 2 inches wide have been removed. The

operation was completed by suturing the skin edges together with silk-worm gut after all hemorrhage was controlled. A tight elastic bandage was applied, and the patient returned to bed where the leg was kept constantly elevated.

It was not thought wise to duplicate this procedure on the inner side of the leg until we were able to judge the degree of improvement wrought by the first operation. After eight days it was obvious that, to obtain a good cosmetic result, further removal of tissue from the inner side of the leg was necessary. Nine days after the first operation a similar operation was performed on the mesial side of the leg.

Immediate recovery from each operation was satisfactory and uneventful. Measurements of each leg before the patient was discharged showed that the ankle of the affected side was ½ inch greater in circumference, the calf was the same, and the knee was 1 inch greater than the normal leg.

What the ultimate curative effect of this operation in this case will be we do not know. An elastic bandage or stocking must be worn after the operation until it is certain that the deep lymphatics of the leg have taken over completely the work of draining the superficial layers of tissue. However, the immediate cosmetic results of the operation in this case were most satisfactory.

ABDOMINAL WOUND RUPTURE

HOWARD M. CLUTE

EVERYONE who does abdominal surgery is liable, at some time, to be faced with the unpleasant problem of dealing with a wound in which the sutures have given away. The following case report is an example of such a complication, occurring after cholecystectomy for gall-stones in a patient having severe diabetes and pulmonary tuberculosis.

Mr. E. C. S. had had pulmonary tuberculosis since 1919. This condition is now quiescent. Although he still coughs and has some sputum no tubercle bacilli were found in it. Six months ago sugar was found in his urine, and since that time he has been under treatment for diabetes with diet and insulin. For the past six years he has had symptoms consistent with gall-bladder disease, and at repeated intervals has had attacks of gall-stone colic. His examination showed definite evidence of cholecystitis with stones, a true diabetes, and a quiescent tubercular process in the right lung. After consultation with the Medical Department it was deemed best to remove the gall-stones, because of his frequent attacks of pain and the danger of pancreatic infection. He was operated upon on September 20, 1927, under regional anesthesia, with a little ethylene gas during the dissection of the bile-duct and the actual removal of the gall-bladder, which contained many stones. The wound was carefully sutured in layers with continuous No. 2 chromic catgut sutures to the peritoneum—with interrupted No. 2 sutures to the fascia, and with silk-worm gut to the skin. A tight swathe was kept constantly in place after operation.

The patient's immediate postoperative condition was very satisfactory except that he had considerable aggravation of his coughing in spite of many sedatives. At no time did the patient

have any sensation of rupturing his abdominal stitches while vomiting or coughing. About forty hours after operation his abdomen became somewhat distended and the patient became nauseated. This distention increased, and on the third day after operation was very marked. Vomiting then occurred, and persisted in spite of gastric lavage and intravenous fluids. The wound was carefully inspected, but no trouble was to be noted by this means. It was then painted with iodin, and a probe inserted between two sutures in the skin. By this procedure it was at once obvious that the deeper layers of the wound had given way, and that we had a rupture of the wound with which to deal.

After a further consultation with the Medical Department the patient was taken to the operating room, regional anesthesia induced, and his wound sewed with many double silkworm gut sutures which were passed through all the layers of the abdominal wall including the peritoneum. A small rubber dam drain was inserted at the upper and at the lower angles of the wound. Cultures from the wound made at this time showed a growth of staphylococcus.

Postoperative recovery in this case was very satisfactory. The distention soon disappeared; vomiting ceased within twelve hours, and the further recovery was uneventful. The stitches were removed on the twelfth day, and adhesive strapping applied tightly to the skin. The wound appeared solid when the patient was discharged from the hospital.

The rupture of this wound was undoubtedly related to the mild infection, and to the constant postoperative coughing.

It is our opinion that divulsion of the peritoneal and fascial layers of abdominal wounds because of the breakage of the deep suture lines is not uncommon. From our experience we believe that the condition must frequently be present, and unrecognized because unsuspected. Varying degrees of wound rupture occur. A small bit of omentum may push its way up through the peritoneal suture line and be largely held back by the fascial stitches, so that only one or two sutures in the fascia are broken or torn out. In other cases the entire suture lines in the deep layers of the wound are broken, and omentum or intestines or both are to be

seen pushing through the skin sutures. In rare instances all the sutures in the wound give way, including the skin stitches, and part of the abdominal contents are found lying outside the wound on the abdominal wall.

The chief causes of rupture of abdominal wounds are (1) inadequate or improper suturing of the layers of the abdominal wall, (2) infection of the wound. Rupture most frequently occurs in upper abdominal wounds such as those made for gall-bladder and stomach operations. In this portion of the abdomen the transversalis muscle is thick and the direction of its fibers is almost at right angles to the usual incision. Furthermore, the fibers are well adherent to the parietal peritoneum so that, when the transversalis and peritoneum are cut, the transversalis tends to pull the peritoneal edges of the wound outward. In closing these wounds great care must be taken that the transversalis is pulled together as well as the peritoneum. Failure to do this results in the formation of a small aperture in the peritoneal suture line by the lateral pull of the transversalis through which the omentum readily forces its way. Such a wedge of omentum pushing through the peritoneal line of suture rapidly increases in size, and breaks through more and more area of the wound. Even very stout chromic catgut sutures will give way under this pressure with resulting wound rupture of greater or less degree.

Wound infection, is of course, a generally recognized source of possible wound rupture. Catgut sutures rapidly disintegrate under bacterial action in such wounds, and this, combined with forceful coughing or vomiting, is a frequent precedent of a ruptured wound.

The presence of a ruptured wound is frequently not to be recognized by simple inspection of the skin surface of the wound. We have learned that in many cases it is necessary to investigate the deeper layers of the wound in the presence of certain post-operative signs and symptoms. We suspect that the deep sutures in the abdominal wound would have given way, when the patient reports that he felt something snap or give way in the wound as he strained, coughed, or vomited. In such a case we inspect the

deep layers of the wound with a sterile probe passed through the skin wound after it is carefully painted with iodin. If the wound is ruptured beneath the skin surface, the probe will pass freely into the abdomen and may be moved up and down in the deep layers of the wound without encountering any obstruction. The ease with which the probe passes inward after going beneath the skin is so great that it may readily slip out of the fingers which hold it, as it fails to meet the expected resistance of the deep layers of fascia. There is frequently a leakage of much clear serum in such a wound after a skin suture has been removed.

We inspect the deeper layers of the wound in search of possible rupture, when vomiting and marked distention with a soft abdomen occur after laparotomy. It has become apparent to us that rupture of the peritoneum and fascia may well be present, although the skin wound is well united. Deep rupture of this type is frequently accompanied by mild degrees of intestinal obstruction. This is apparently due to the protrusion and adherence in the wound of loops of intestine. We know of no way of discovering the condition in such cases except by first suspecting it and, second, looking for it with a probe.

It is our opinion that many postoperative ventral hernias start within a very few days of operation with a rupture of the deep layers of the wound which is unrecognized. Many patients with old ventral hernias will report a very stormy course after their original operation marked by long continued vomiting and distention due in many cases, we believe, to ruptured wounds.

The recognition of a complete or nearly complete rupture of an abdominal wound is simple, provided one inspects the wound. In these cases no probing is necessary because omentum or gut may be seen protruding between the skin sutures.

There are two ways of treating postoperative ruptures of the wound. One may be called the palliative method and the other the radical method. With the former method, bands of adhesive tape are applied from far on one side of the patient's abdomen to the other side, with the plan of holding the abdominal wall firmly together. This method we never use, unless the patient's general

condition is so serious that no form of anesthesia can be employed that will permit resuture of his wound. We have used this method once in a patient who had lobar pneumonia and was extremely ill when his wound ruptured. The method of choice, in our hands, is the insertion of double silk-worm gut sutures through all the layers of the abdominal wall under an anesthetic. We place these sutures very closely together ($\frac{1}{2}$ to $\frac{3}{4}$ inch) and tie them tightly. Care must be taken that no loop of gut or omentum comes beneath or between the sutures. We place a rubber-dam drain in the upper and lower angles of the wound, and reinforce the sutures with a wide adhesive swathe.

We have used gas and oxygen, ethylene and oxygen, ether, spinal and regional anesthesia in these cases as occasion demanded. Whatever the anesthetic used it must be sufficiently complete to give relaxation of the abdominal wall. Muscular straining in the presence of intestinal distention makes the suture in these cases all but impossible.

We cannot recall a fatality from a postoperative wound-rupture, except in the instance of the patient with lobar pneumonia whom we have previously mentioned. The immediate results of this method of suture are also very satisfactory. The distention and vomiting are generally relieved within twenty-four hours, and convalescence becomes normal. The sutures often become quite irritating, and some mild infection is generally present about the suture holes. In spite of this, however, we leave the sutures in place for at least twelve days and often for fourteen days. The condition of these resutured wounds long after operation is likewise surprisingly good. Rarely does a hernia occur—in fact we cannot now recall a later hernia in a wound of this sort. In our experience, the immediate closure of ruptured wounds, with numerous interrupted silk-worm gut sutures passing through all layers of the abdominal wall, is the method of choice for treating this postoperative complication.

ENTEROSTOMY IN PERITONITIS

HOWARD M. CLUTE

THE value of enterostomy in acute intestinal obstruction is generally conceded by most surgeons, although it is recognized that many cases of acute obstruction die in spite of drainage of the intestinal lumen. These cases which are not saved by enterostomy are frequently the long neglected patients, many of whom are moribund when the operation is performed, and can not justly be brought as arguments against a method of treatment which has many brilliant successes to its credit.

Enterostomy was used in obstruction at least twenty-five years ago. Professor Heidenhain reported 5 patients on whom he had performed this operation with four recoveries at the thirty-first German Surgical Congress in 1902. Victor Bonney in England reported 6 cases in 1916 of acute intestinal obstruction treated by enterostomy who recovered. It is of interest to note that both Heidenhain and Bonney recommended and used enterostomy for the intestinal obstruction that developed secondary to peritonitis. The value of enterostomy in this condition is not, however, very generally accepted at the present time. In fact, until very recently, but little has been heard of the use of enterostomy in the treatment of the distention and obstruction that accompanies peritonitis even though this was the condition in which it was used by its earliest exponents.

Paralysis of portions of the intestine occurs with peritoneal inflammation. At first the paralysis is localized in the loops of gut that are in close proximity to the source of infection. As the peritonitis extends, further areas of paralysis appear in the intestine. There will be found in these cases portions of gut showing marked inflammation of the peritoneal coat and paralysis of the musculature, separated by other apparently normal por-

tions of intestine. As the infection spreads, the paralysis becomes greater and the distention more marked.

The clinical picture presented by a case of diffuse peritonitis and a case of acute mechanical intestinal obstruction is in many respects the same, and the diagnosis of these two conditions is oftentimes impossible before operation, so alike are they in their chief characteristics. Furthermore, the changes in blood chemistry which accompany acute intestinal obstruction are frequently exactly duplicated in diffuse septic peritonitis. Thus, in either condition, we may find the blood chlorids lowered and the non-protein nitrogen and carbon dioxid combining-power of the blood elevated.

It is not unreasonable to assume that in peritonitis we are dealing not only with a bacterial infection of a large serous cavity, but also with a secondary obstruction to the intestinal canal. It is conceivable that the factor that determines the outcome in certain cases of peritonitis is the degree of intestinal obstruction that accompanies the infection of the visceral peritoneum. It is therefore logical to assume that treatment which is beneficial in acute intestinal obstruction will at times be of value in the treatment of septic peritonitis. By the drainage of the lumen of the intestine in peritonitis some patients may be saved who otherwise would die.

To prove such an hypothesis by clinical experience is well-nigh impossible. In each case under consideration the actual result must be compared with a theoretical result. We believe that, if we had not performed an enterostomy in certain cases of peritonitis, the patient would have died—but we cannot prove that. We have, of course, had patients with diffuse peritonitis recover who never had an enterostomy performed. But we believe that enterostomy added to the other measures for the treatment of peritonitis has saved some of our cases and we believe it is logical that this should be the case.

A boy of seventeen was seen in a nearby town in June, 1927. For three and a half days before calling his physician he had been sick with abdominal pain and vomiting. He had taken several cathartics during this time with little result. Examina-

tion showed a boy with an anxious face, sunken eyes, and pinched nostrils. His pulse rate was 120, his temperature 102° F., and his respirations 30. Examination of his head, chest, and extremities revealed no abnormality. His abdomen was distended, tense, and tympanitic. Tenderness and muscle spasm were generally present, but were particularly marked below the umbilicus. Rectal examination showed marked tenderness on the right side of the pelvis. A diagnosis of appendicitis was made and immediate operation undertaken. The abdomen was opened in the lower right quadrant and much foul-smelling pus exuded. The small intestine in the field was distended, inflamed, and had many fibrin deposits on its surface. The appendix with a perforation at its base was readily found. No attempt at any walling off of the source of infection by gut or omentum was evident. The appendix was removed, and a cigarette-drain inserted to the pelvis over the appendiceal stump. A small incision was now made high in the left upper quadrant of the abdomen. Much infected fluid here escaped and the gut was seen to be distended and injected in this portion of the belly. A loop of jejunum was picked up and a catheter sutured in place. Omentum was placed between the enterostomy and the abdominal wall and the wound closed about the tube.

This patient made a rapid and complete recovery from his peritonitis. He had been vomiting repeatedly before operation but did not do so after operation. His enterostomy tube drained copiously for the first twenty-four hours and was clamped off after forty-eight hours. It came out on the seventh day with immediate closure of the fistulous tract. During this patient's postoperative period he was given 3000 c. c. of salt solution subpectorally each day, and nothing by mouth for forty-eight hours. Water was then given him freely both by mouth and by rectum. He was kept in the exaggerated Fowler's position for the first week. For the first thirty-six hours after operation he was kept absolutely quiet with repeated doses of morphin.

As we have said above we realize that in this case we have no proof that enterostomy saved this patient's life—but we believe it did. His freedom from postoperative vomiting and distention,

and his easy convalescence were, in our opinion, due to the relief of the intestinal obstruction that accompanied his peritonitis by jejunostomy.

We have performed a jejunostomy in 7 cases of peritonitis. Of these 1 died of embolus several days after operation, 1 died of pneumonia five days after operation, and 1 died of peritonitis. The other 4 patients recovered. Of the 7 cases, 6 were relieved of their peritonitis after jejunostomy.

We have drained the ileum in 6 cases of peritonitis, and only 1 patient recovered. We have drained the cecum in 8 cases of peritonitis, and only 1 patient recovered.

These patients show what would be anticipated if the theory that intestinal obstruction is a large factor in the cause of death in peritonitis is correct. The higher the drainage in the small gut is inserted, the better the opportunity of draining the toxic products of obstruction. Thus, in a study of acute intestinal obstruction, we found in 6 cases of simple (non-peritonitis) obstruction treated by jejunostomy that 5 recovered and 1 died; and in 20 cases of obstruction treated by ileostomy, 9 recovered and 11 died.

The insertion of a catheter into the lumen of a distended ileum at or just above the point of obstruction is not as efficacious in obstruction as the drainage of the jejunum for two reasons. First, the distended gut has lost its power to contract and expel the toxic products it contains and, second, these toxic products products collect in the gut far above the actual point of obstruction. It is important then in doing an enterostomy for peritonitis that the catheter be inserted in the jejunum well above the paralyzed, distended intestine. Failure to do this may account for some failures credited to the procedure.

We place our incision for jejunostomy just above the level of the umbilicus and well to the left of the rectus sheath. Here one usually encounters first the omentum, and beneath this is found jejunum. We believe it is important to go high enough in the jejunum to obtain a loop which is neither inflamed nor distended, and which is obviously not merely a non-infected portion of a section of infected bowel. It is our custom to bring

the loop of gut partly out of the wound and place a right angle intestinal clamp on it. We then place a purse-string suture in the gut, and hold the suture by the two ends and the middle to form a sling supporting the gut. A small opening is now made in the gut and, as a catheter (No. 16) is inserted, the loop of cat-gut suture is pulled up about it. This purse-string having been tied, the needle is carried through the catheter and the thread

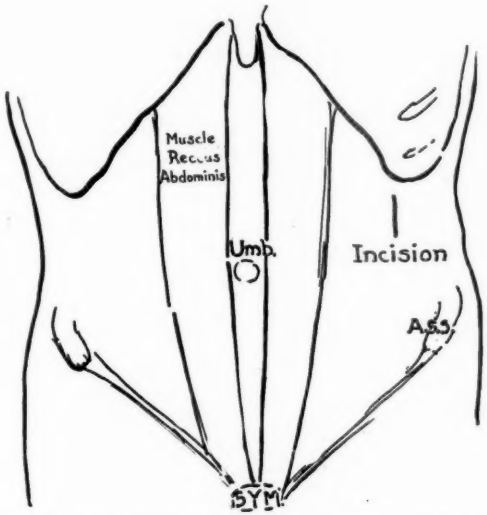


Fig. 44.—Diagram showing the location of the small incision which is used to do a jejunostomy. On entering the peritoneum through this incision the transverse colon and omentum are pushed back and loops of jejunum usually are found immediately beneath.

tied to prevent the catheter from slipping out of the gut. The clamp is now removed from the gut, and a second purse-string suture placed above the first one and made to surround it. If the incision is a very small one in the abdominal wall, it is often very convenient to reduce the loop of gut before applying the second purse-string suture which materially increases the bulk of intestine that must be reduced. After tightening the second purse-string suture the catheter is carefully passed through a

piece of omentum, and this suture is then used to catch and hold the omentum over the point of enterostomy. Closure of the abdominal wall about the catheter requires but a few sutures. The entire operation can readily be performed with novocain anesthesia.

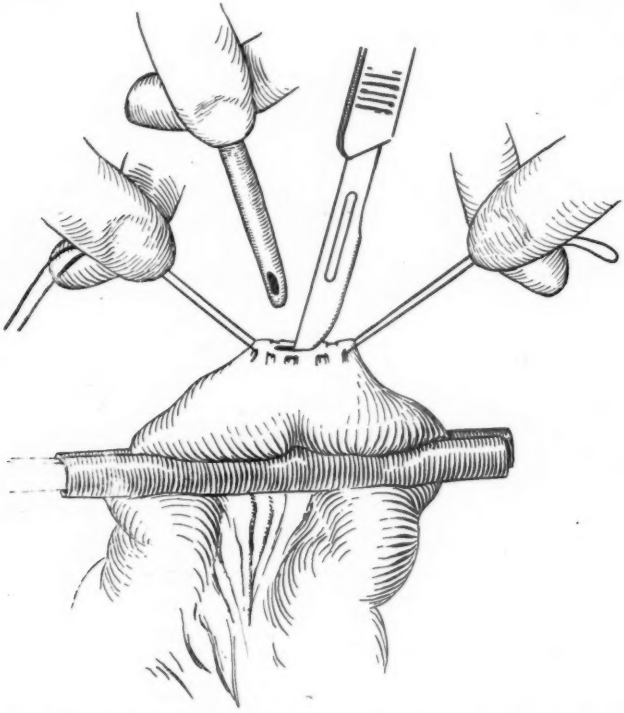


Fig. 45.—The intestine has been pulled out of the wound and clamped lightly with a rubber-covered stomach-clamp. A purse-string suture has been placed, inside which a small incision is made and the catheter immediately inserted. This practically prevents any leakage of intestinal contents.

After the dressings are applied to the wound, the clamps are removed from the catheter and constant drainage is established. If the catheter has been placed in the jejunum the material from it will be similar to the vomitus in many instances. It is not

necessary, as a general rule, to continue the drainage from the jejunostomy for more than forty-eight hours. In this time the toxemia of obstruction will be relieved, and the tube should be clamped off except when it is used for the introduction of salt

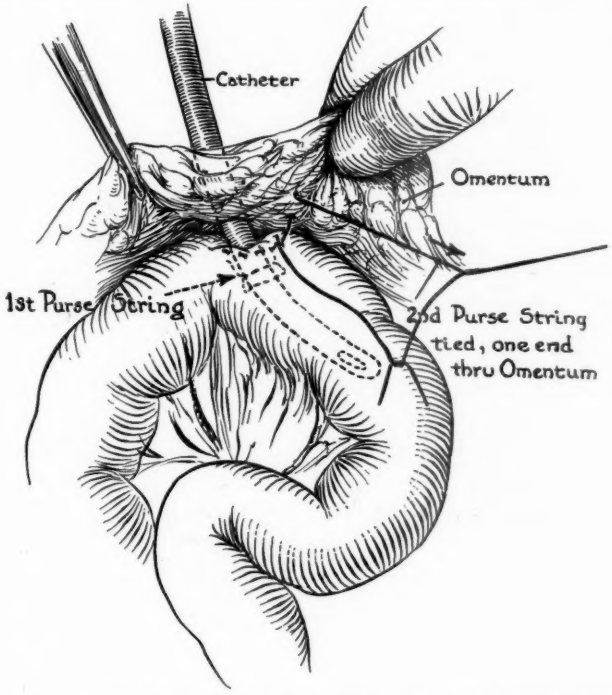


Fig. 46.—The first purse-string suture has been tied about the catheter, after which the suture is carried through the catheter, which anchors it securely, in the gut. The second purse-string suture is now made above the first to further invert the catheter. The catheter is now drawn through a piece of omentum, which is lightly caught by the second purse-string to hold it down against the point of entrance into the intestine.

solution or glucose into the bowel. As soon as the toxemia of obstruction is relieved continued drainage from a jejunal catheter should not be permitted. Haden and Orr have shown that dogs with high jejunal drainage lived only two to five days, a shorter

time than when simple obstruction was caused at the same point. And they found that with a high jejunostomy chemical changes occurred in the blood similar to those of high intestinal obstruction.

In our experience the catheter slips out in six to eight days after operation, and the fistula closes at once. We have not had

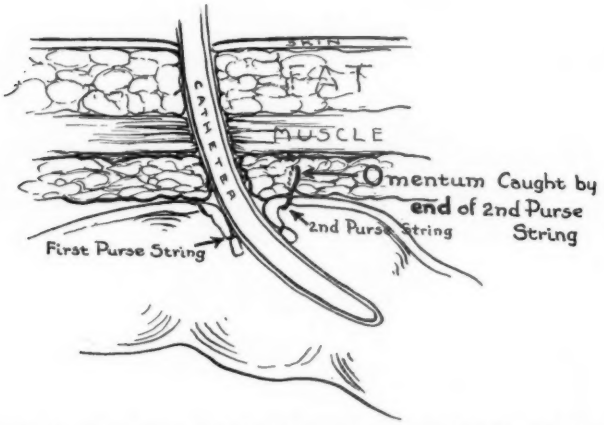


Fig. 47.—Cross-section of the abdominal wall and intestines with catheter in place. Note the omentum which lies between the peritoneum and the intestine and completely surrounds the point of entrance into the gut.

a persistent fistula or an infection of the abdominal wall after jejunostomy.

We do not feel that we have any proof that jejunostomy will save the life of patients with peritonitis. We do believe, that the procedure is a logical one to use in peritonitis and that it should be more frequently employed. We believe it has been of value in the few cases of peritonitis in which we have employed it.

THE OBLITERATION OF DEAD SPACE AFTER THYROIDECTOMY. A POINT IN TECHNIC

HOWARD M. CLUTE

FOR some years we have closed the majority of thyroidectomy wounds without drainage. We have repeatedly demonstrated Dr. Lahey's suggestion that drainage of these wounds in even very toxic patients was of no importance in relation to the degree of postoperative toxic reaction. We therefore eliminated the presence of toxicity in the thyroid patient as an indication for drainage at operation and have never had any cause to change our procedure in these cases.

The indications for draining a thyroidectomy wound in our experience, therefore, are simply those indications which are accepted for drainage in any surgical procedure. We drain these wounds if there is a persistent ooze or if there is a deep pocket in which a hematoma may form, and in those rare instances in which a thyroid infection is found at operation. We have recently altered our technic of wound closures after thyroidectomy so that postoperative oozing is more completely controlled and certain pockets that would otherwise persist are obliterated. By these changes in technic it is possible to close many more wounds completely than has heretofore been deemed advisable.

It is our custom to apply clamps to the sternohyoid and sternothyroid muscles, cut them transversely, and reflect them from the thyroid gland before proceeding with a thyroidectomy. This cutting of the prethyroid muscles is essential to an adequate exposure of the operative field in all thyroid operations, except possibly those cases of removal of a very small discreet adenoma. When these muscles are cut transversely it will be found that the sternothyroid muscle will not be cut completely across. There remains an uncut portion beneath the sternomastoid muscle

which overlies the lateral borders of the thyroid gland on each side of the neck.

Immediately inside and beneath this thin layer of the sternothyroid muscle lie the internal jugular vein and common carotid artery. Mesial to these is the area previously filled by the en-

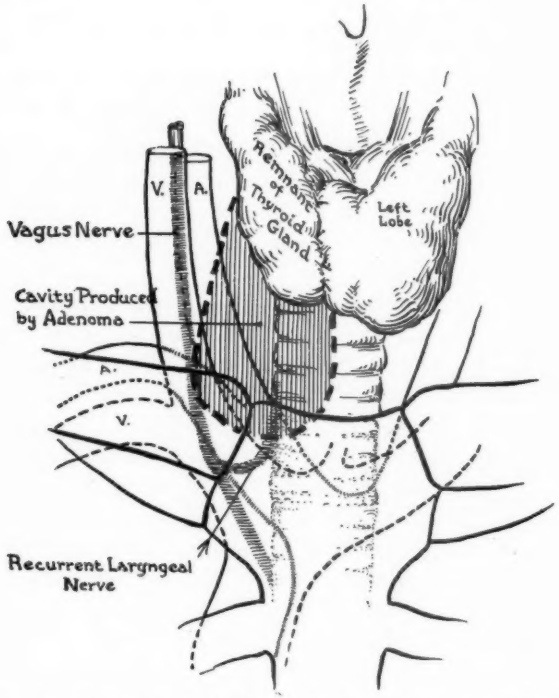


Fig. 48.—Diagrammatic drawing of the important structures in the neck and their relation to the cavity produced by a thyroid lobe which is partly substernal.

larged thyroid lobe, partially filled with the remnant of thyroid tissue remaining after thyroidectomy. At the lower angle of the wound is a pocket that varies in size with the size of the inferior pole of the thyroid gland before operation.

When sufficient thyroid tissue has been removed from the

lobe, particular care is taken to check all oozing from the cut surface of the gland. This is best accomplished by folding the outer edge of the thyroid remnant into the midline of the neck. Often

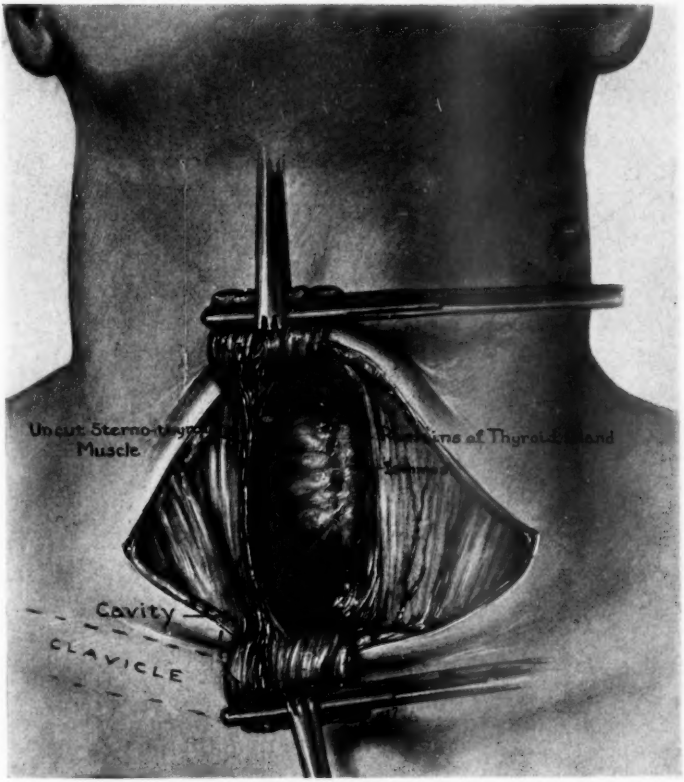


Fig. 49.—A large part of the right lobe of the thyroid has been removed, leaving a cavity which extends beneath the clavicle and sternum. The remnant of the thyroid gland has been stitched over to the isthmus. Note the ragged, uncut portion of the sternothyroid muscle lying just inside the sternomastoid muscle.

this will leave no raw surface visible, but in many cases it will not be possible to completely turn in the thyroid remnant in this way. The uncut portion of the sternothyroid muscle is picked

up with fine catgut stitches and carried over the thyroid remnant to the midline (Fig. 50). These stitches must be so placed that the muscle is held closely in contact with the raw gland surface (Fig. 51). The contact of the muscle tissue checks all ooze from the gland surface most effectively.

It is very common in thyroidectomy to find that one or both lower poles of the gland are to some degree subclavicular. This

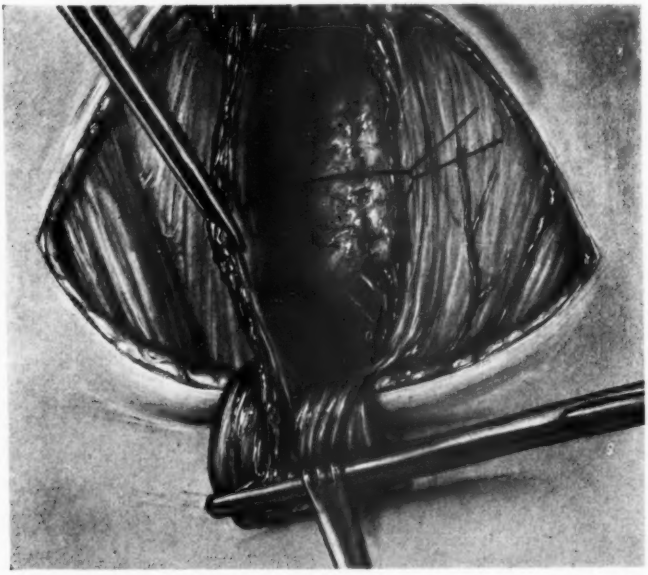


Fig. 50.—The first stitch has been taken from the posterior surface of the sternothyroid muscle well back from its uncut edge to the side of the thyroid remnant. This will lay the muscle in close relation with the gland and help control any ooze.

is especially common in low-lying adenomata of the thyroid, but it may also be noted to a certain degree in large hyperplastic glands. When these glands are removed there remains in the lower angles of the wound on either side of the trachea a cavity of varying size extending toward or into the superior mediastinum. We have felt it imperative to drain all these cavities in

the past, in order to prevent the occurrence of a hematoma or mediastinitis. Recently, however, we have been able to obliterate many of the cavities by drawing up the loose cellular tissue of their walls to the cut portions of the sternothyroid muscles, and to the trachea. Figure 52 illustrates the steps in this procedure.

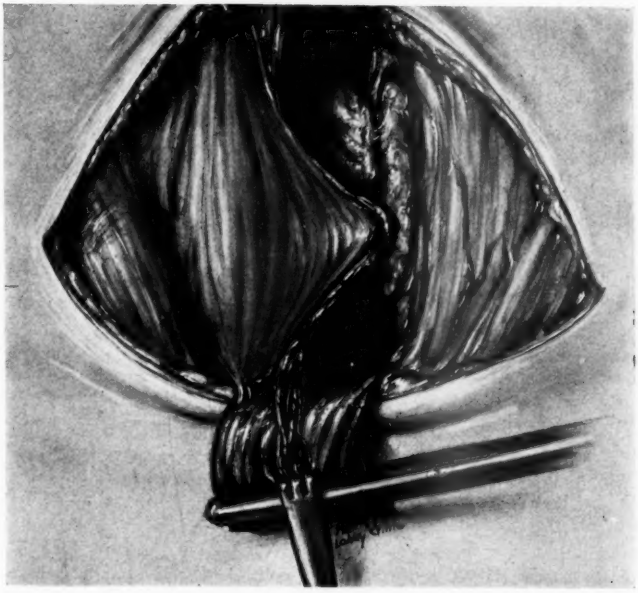


Fig. 51.—The first stitch has been tied, pulling the remnant of sternothyroid muscle over the rough surface of the thyroid gland.

It is, of course, essential that the fine stitches obliterating these cavities be most carefully placed. Care must be taken to avoid catching any of the important structures lying in this neighborhood, such as the recurrent laryngeal nerve and the internal jugular vein. These structures can be readily seen and avoided, and the forceps carefully made to pick up just the loose cellular tissue of the cavity wall.

The stitch is started in the lower portion of the piece of thy-

roid tissue left after thyroidectomy. It then picks up the loose cellular tissue of the cavity wall in two or three places, and is passed into the posterior aspect of the lower end of the sternothyroid muscle. When this and other similar stitches are tied they tend to obliterate the cavity in which the adenoma formerly lay. The procedure is markedly assisted by lowering the

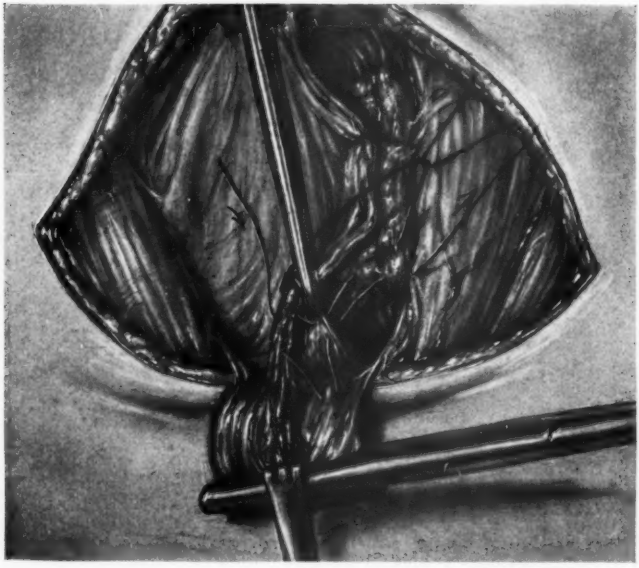


Fig. 52.—The loose cellular tissue of the wall of the cavity from which the adenoma has been removed is caught in a stitch which also includes the thyroid isthmus and the sternothyroid muscle. When this and other similar stitches are tied the cavity is completely obliterated.

cross bar used to elevate the patient's neck during thyroidectomy, and by releasing the traction on the lower muscle segments, held in a clamp.

By these procedures the number of patients requiring drainage after thyroid operations has been materially reduced. It is often very surprising to note the ease and completeness with which a relatively large subclavicular or substernal cavity can

be either reduced in size or completely obliterated. If an ooze still persists, a small piece of rubber-dam may be inserted from one lateral angle of the wound and left in place for two or three days. If a large substernal goiter has been removed, we believe that the pocket from which it came must be drained with a

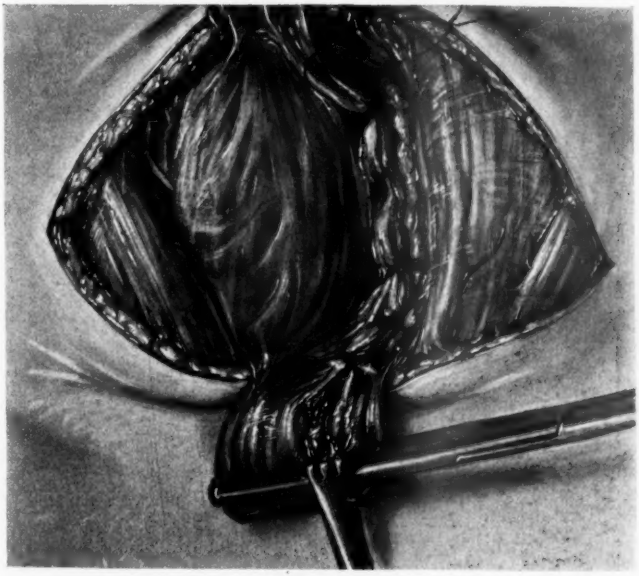


Fig. 53.—Final closure of the wound shows the cavity from which the adenoma was removed completely obliterated. The thyroid remnant is covered with muscle tissue. No drainage is now required, since no cavity remains to collect blood or serum.

cigarette-drain. We make no attempt to obliterate cavities much more than 2 inches in diameter. The improvement in scar, and the diminution of the chances of infection, however, makes the obliteration of small cavities by this method worthy of use.

THE TECHNIC OF COLOSTOMY CLOSURE AFTER A MIKULICZ RESECTION OF LARGE INTESTINE

HOWARD M. CLUTE

IN a considerable experience with large intestine resection by the extraperitoneal method of Mikulicz we have been increasingly impressed with its value. The Mikulicz technic avoids the possibility of infection of the peritoneal cavity; it gives opportunity for the relief of distention of the gut proximal to the resection, and in most cases it is not difficult to do. An objection to the operation, however, is the fact that in many cases the colostomy opening must be closed after the spur between the proximal and adjacent portions of intestine has been destroyed, for only very rarely, in our experience, will this colostomy close spontaneously. Although the closure of this colostomy does necessitate another operation and some discomfort, it can, however, be done extraperitoneally without danger, and with considerable certainty that the operative measure will produce a permanent and normal continuity of the large intestine. We wish to describe the technic which has developed in the Clinic for the closure of the colostomy that persists after a Mikulicz resection of the large intestine.

The preoperative and postoperative management of these cases is in many respects nearly as important as careful operative technic. It is essential, likewise, that the spur between the two pieces of gut be fully cut down. No colostomy will close if there is any obstruction distal to it.

Two days before operation the patient is given $1\frac{1}{2}$ ounces of castor oil. Two hours after this cathartic, enemata by rectum and through the colostomy are given if necessary to assist in the evacuation of the bowels. The morning after the castor oil has been given, deodorized tincture of opium, ♏ viij, is given three

times a day. Further enemata and rectal irrigation are given if the large intestine is not thoroughly and completely evacuated. During this preoperative period, furthermore, the patient is given a diet which will produce a very small residue.

We have found spinal anesthesia to be very satisfactory in these patients, although a general anesthesia is not contraindicated when the patient's condition is satisfactory. The technic of the closure is well shown by the artist's drawings. The

Fig. 54.—The mucous membrane of the intestine is seen protruding from the abdominal wall. Note the line of incision about the gut, and its extension into the scar of the previous operation. Note the margin of skin left attached to the mucous membrane.

first incision encircles the colostomy, and is made in the skin at a distance of $\frac{1}{8}$ inch or less from the junction of the intestine with the skin. This incision is now carried down into the fat of the abdominal wall, until the cuff which contains the mucous membrane of the intestine is free on all sides down to the fascia. In dissecting the fat away from the side of the colostomy considerable care must be exercised not to perforate the intestine in some lateral extension which protrudes beneath the line of the incision. We have occasionally put a finger in the colostomy to make cer-

tain of its lateral extension. When the fascia has been well exposed above and below the colostomy, it is also incised all around the wall of the intestine. When the colostomy has been made through the rectus muscle the muscle will be in evidence just beneath the edge of the fascia. The muscle and fascia are now carefully dissected away from the base of the intestinal tube until

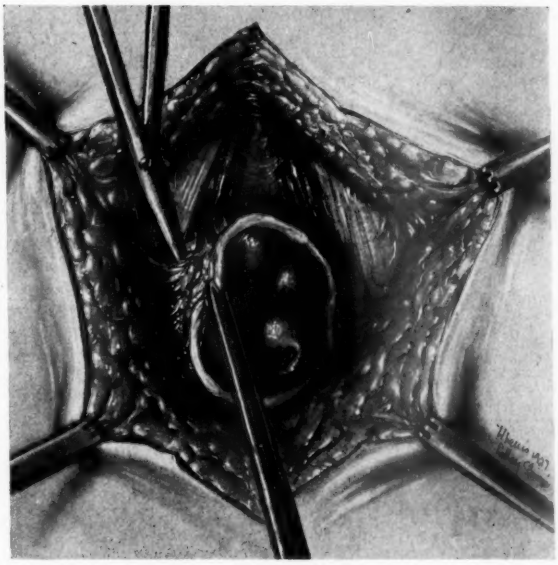


Fig. 55.—The skin and fat have been carefully divided down to the muscle and fascia which can be seen at the upper part of the illustration. Great care must be taken in dissecting the tissue about the colostomy that a button-hole incision is not made through some portion of the mucous membrane which extends outward into the fat.

the properitoneal fat and peritoneum are in evidence all around the colostomy. The intestine is now ready for closure.

The first step in the actual closure of the intestine is the removal of the small margin of skin which is adherent to the mucous membrane around the circumference of the intestinal opening. This gives a raw, clean surface of intestine which can

be inverted with a running in, out, and over suture. When the first suture of the opening of the intestine has been completed it is our custom to further invert this with another layer of intestinal sutures.

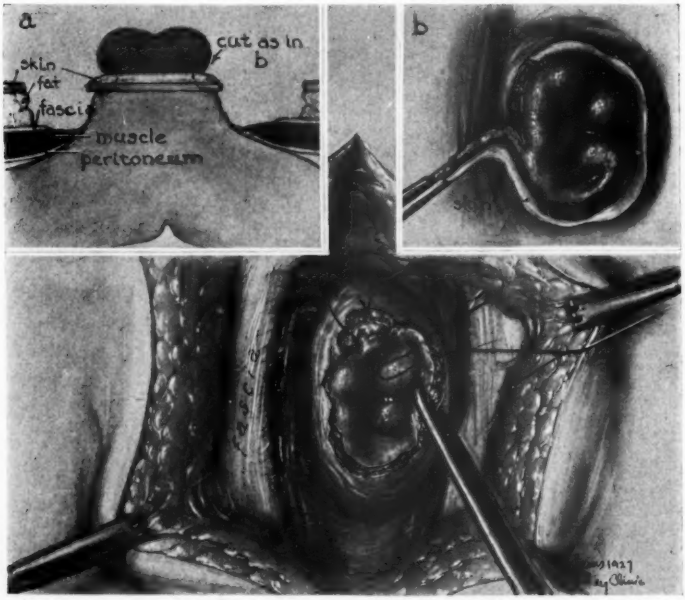


Fig. 56.—The muscles and fascia have been carefully and completely dissected away from the base of the intestine which protrudes to form the colostomy. An in, out and over stitch is being placed to invert the intestinal opening. In *a* we note a diagrammatic cross-section of the structure shown in the large sketch. Note in *b* the removal of the mucocutaneous junction which gives a raw surface of mucosa for inversion. After the stitch which is shown has inverted the intestine, another line of sutures are placed to further cover the line of closure.

The colostomy opening now lies beneath the level of the rectus fascia and muscle. Fine catgut sutures are placed in the muscle belly to pull this lightly together. Interrupted sutures of chromic catgut are now placed in the rectus fascia which comes together quite readily over the inverted bowel. At the

upper and at the lower end of the fascial sutures a small rubber tissue drain is inserted down to the region of the intestine. The skin and fat are closed with interrupted silk-worm gut stitches. It is a good plan to insert a rubber-dam drain into the superficial fat above the fascia through the center of the wound.

The postoperative care in these cases is very important, and upon its thoroughness the success of the operation not infre-

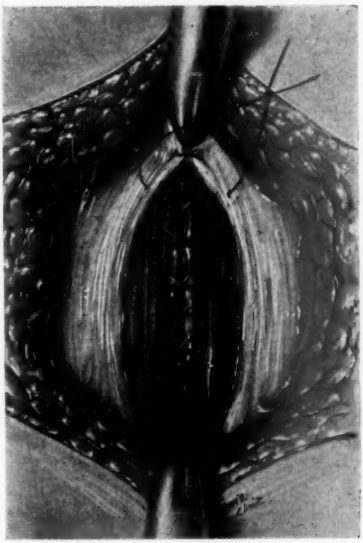


Fig. 57.—Fine catgut sutures have been placed in the muscle to draw it gently together over the colostomy opening and heavy catgut sutures are being placed in the fascia. Note that drains are inserted down to the point of closure of the colostomy beneath the muscle.

quently depends. The deodorized tincture of opium, ♏viij, is given three times a day for six to eight days. The diet is limited to liquids without milk. A rectal tube is inserted in the rectum and kept in place all the time. It is not uncommon for a patient to have a very slight amount of gas leakage through the wound, if the rectal tube is omitted in the first few days. After the eighth day the diet is gradually increased to soft solids, and then to full

diet. On the ninth or tenth day the bowels are opened by the use of warm oil, retained for six hours in the rectum and followed by very small enemata. If a satisfactory evacuation is not thus obtained a mild cathartic can be given. We find divided doses of milk of magnesia very satisfactory.

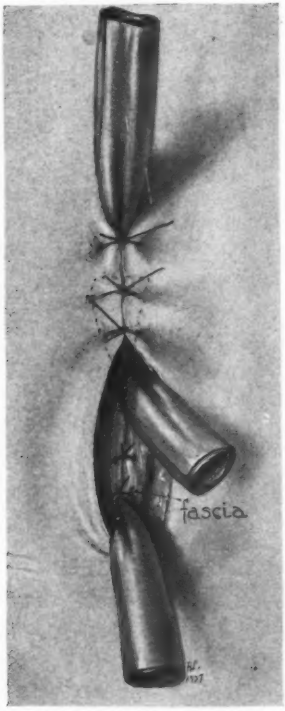


Fig. 58.—Final steps in the closure of the colostomy. Drainage is placed to the fat in the middle of the incision. At the upper and lower ends are seen the drains which go beneath the muscle to the sutured intestine.

Occasionally a small amount of infection occurs in the wounds, but, with the adequate drainage suggested, this has never given any serious trouble. Occasionally, a small amount of gas escapes and, rarely, fecal drainage occurs through the wound on the third or fourth day after operation.

In our experience this leakage also clears up very rapidly after the bowels are again tied up with opium and the diet limited. We have never seen any infection in the peritoneal cavity when this technic was followed. We have not failed to obtain closure of the colostomy by this method after a Mikulicz resection of large intestine.

THE TECHNIC OF TRACHEOTOMY

HOWARD M. CLUTE

THE operation of tracheotomy, whether it be performed as an emergency or as an elective procedure well repays a meticulous attention to the details of its technic. It is desirable that a wide open and efficient airway be established, and that possible complications of the operation such as lung abscess and pneumonia be avoided. The technic of tracheotomy which we use in the Clinic has filled these requirements most satisfactorily, and for this reason is presented. Practically all of the steps in the operation have been described by other writers, and we have merely adopted their various suggestions and combined them as our experience has indicated.

The operation is best performed under local anesthesia. The skin incision which we have found very satisfactory is a transverse one placed a finger's breadth above the sternoclavicular junction. The incision is made as in a thyroid operation. The skin is lightly marked, and then with scissors the skin, fat, and platysma muscle are raised from the pretracheal muscles and divided. Double hooks are placed on the upper flap of the wound for traction, and by sharp dissection it is freed from the pretracheal muscles for a distance of about 2 inches. The bleeding points in the uncovered area are now carefully controlled with ties, if the patient's condition is such that the time can be taken. It is very important that in all the stages of the operation a perfectly dry field be maintained in order to do away with the inhalation of blood when the trachea is opened.

The next stage in the procedure is to separate in the midline the sternohyoid and the sternothyroid muscles, after the proper line of cleavage between these two muscles is determined. They may be separated with almost no bleeding. Retractors are now

placed to hold these muscles back, and it will be seen that the trachea is readily visible in the midline beneath them. All bleeding vessels at this time must be carefully caught and tied in order to continue the dry field. At the upper angle of the wound will be seen the isthmus of the thyroid gland and descending from it are veins which vary in their size and course in

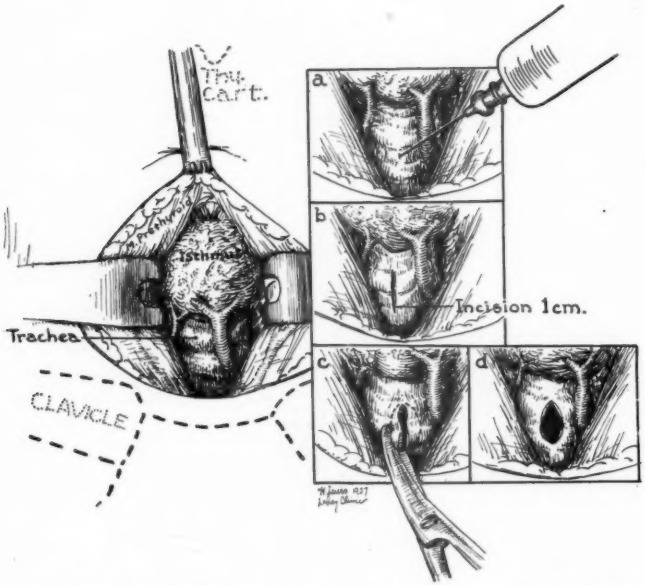


Fig. 59.—The trachea has been adequately exposed by retraction of the prethyroid muscles. In *a* is shown the injection of 5 per cent. cocain solution into the trachea before its incision to prevent respiratory spasm. In *b*, *c*, and *d* are shown the method of removing portions of the trachea.

each patient (Fig. 59). The skin flap which elevates the anterior cervical muscles being retracted, the trachea is readily available for any procedure. Before making any incision in the trachea a hypodermic syringe with a very fine needle, containing 1 c.c. of 5 per cent. cocain solution, is plunged between two tracheal rings into the tracheal lumen (Fig. 59, *a*). The cocain solution is now injected with considerable force into the trachea. This

produces a momentary spasm of coughing which lasts but a few seconds before the mucous membrane of the inside of the trachea is anesthetized. When the spasm of coughing has subsided, an incision with a sharp knife is made in the midline of the trachea for a length of about 1 cm. (Fig. 59, *b*). The preliminary injection of cocain permits this incision to be made without the terrific respiratory spasms which would otherwise be present. With fine scissors and forceps an elliptical piece of trachea is removed (Fig. 59, *c* and *d*). It is important in removing these

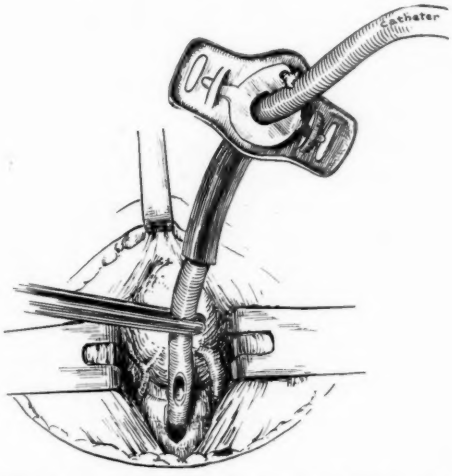


Fig. 60.—Demonstrates the method used for guiding the tracheotomy tube into the trachea when the opening is not readily visualized.

pieces of trachea that they be firmly grasped in order that no fragments be inhaled. It will now be found that breathing is markedly improved, and sufficient time may be taken for any further procedure in the wound which is indicated such as the location of vessels which have already been snapped but not tied.

The insertion of the tracheotomy tube into the tracheal opening has been somewhat difficult in certain cases. We have, however, found that, when the tracheotomy was to be done in a

fat neck, the insertion of the tube was materially assisted if a catheter was threaded first through the tracheotomy tube and then into the trachea (Fig. 60), as has been suggested by Dr. Mason. With the catheter in the trachea as a guide, the tracheotomy tube can be readily slipped into the proper position. We find that the tracheotomy tube which is used should be considerably smaller in caliber than the trachea. This permits the passage of air around the tube and wound through the larynx, and assists materially in phonation. Furthermore, the tracheotomy tube of a smaller bore than the trachea has been found to be distinctly more comfortable to the patient.

When the tracheotomy tube has been adjusted in a satisfactory manner, the muscles are permitted to return to their midline position. No sutures are necessary. The skin flap is replaced above the tracheotomy tube and a few wound clips are inserted on each side of the tube. Wet gauze, moistened with warm water is kept constantly over the opening of the tracheotomy tube. This prevents the marked dryness of the trachea which is very annoying if the patient is permitted to breath dry room air.

The important points in the technic of tracheotomy are: adequate exposure of the trachea; a dry field before the trachea is opened, and the injection of cocain into the trachea before incision.

TREATMENT OF CARBUNCLE

JOHN K. FIFE

EXTENSIVE infective gangrene of the skin and subcutaneous tissues occurring, as it generally does, in individuals run down by debilitating conditions, such as diabetes or acute infections, frequently presents a serious surgical problem. This is particularly so when the patient is seen after a period in which treatment has been neglected or inadequate.

Constitutional disturbance of varying extent may be present even without marked rise in temperature. Glycosuria, which disappears as the condition improves, is not uncommon. If diabetes be a concomitant disease, lack of its accurate management may not only account for unsatisfactory results from surgery, but may lead to a fatal termination of the case through coma or through decreasing resistance to such an extent that the patient dies of a general septicemia.

Various measures have been advocated for the treatment of carbuncle. It is our experience that no one method is applicable to all cases, but that treatment must vary with the location of the lesion, the extent of the infection, and the condition of the patient. If the reaction to conservative methods is not satisfactory, more radical treatment must immediately be instituted. The decision as to when it is necessary to change the treatment is frequently very important.

In all cases a regimen is established tending to improve the patient's general condition. He is placed at rest (in bed) and encouraged to eat of an easily assimilated diet. Fluids are forced in excess of 3000 c.c. per day. If sufficient quantity is not taken by mouth, it is supplemented by proctoclysis and by hypodermoclysis. If sunlight is available in warm weather the patient is given general exposure to it. If the use of actual sun-

light is not practicable, ultraviolet ray lamps are used. In the cases reported, the mercury vapor portable lamp was used, exposures of the trunk and legs being carefully graduated so as not to produce toxicity by overdose. When cases become ambulatory the carbon arc lamp is sometimes used. It is impossible to measure the benefit of such treatments but, in view of the belief that they tend to sterilize the skin and improve the general sense of well being, they cannot be neglected. Sedatives and narcotics are used as indicated.

In considering local treatment, small lesions are reported as being frequently aborted under the application of *x*-rays. This, however, has not been our experience, and our practice has been to apply heat assiduously in the form of compresses or poultices. Compresses of gauze saturated with boric acid solution, as hot as can be borne, are satisfactory, but as they should be changed at least every twenty minutes they require the full time of an attendant. Compresses of saturated solution of magnesium sulphate may replace the above. Large poultices of flaxseed meal, on account of their heat retaining qualities, are found generally applicable and much more effective.

Although the site of carbuncles is usually in the relatively avascular regions—the nape of the neck, the back, or the buttocks—they also occur in such vascular parts as the cheeks or the lips. Here, incision or excision can be considered practically contraindicated in view of the possibility of infective thrombosis of veins which may spread by the venæ communicantes to the cavernous sinus. The most intensive local treatment should be used and the vascularity tends to make it successful in contradistinction to its use without incision in avascular parts.

In an avascular region, with diabetes present, it is usually accepted that incision will be necessary. If diabetes be not present and, after poulticing, the surface of the lesion which has been brawny and edematous shows pustules which burst but provide insufficient drainage for the purulent material and slough beneath, incision or excision must be resorted to.

If the lesion is to be incised, the lines of incision are chosen first to provide adequate exposure of all the gangrenous area, so

that all infected tissue may be removed and healthy tissue only remain. Where the lesion is small, and the site such that the scar will be obvious, natural skin folds can occasionally be utilized. Cruciate incisions are usually used. In rare instances, where the region to be exposed is large, more than one incision in the direction of one of the axes of the cross is required. (This is exemplified in Case II.) When the flaps so indicated are raised and undercut to fresh tissue, the base of the carbuncle is exposed. It is usually made up of grayish slough with liquefied areas which may penetrate deep into the subcutaneous tissues or muscles. It is desirable to remove all of this with curette or by sharp dissection.

Wide excision, beyond the limits of induration, and removing the base is advocated by many. Where the toxemia is extreme and rapid removal of its source is indicated, it is undoubtedly of value, though in many less severe cases it is not necessary to sacrifice so much skin.

Following incision or excision several forms of dressings have been used. A pack of boric acid ointment gauze applied immediately after operation is useful to combat ooze, yet give drainage without occasioning trauma in its removal. This is allowed to remain untouched for forty-eight hours. It is then replaced by a gauze dressing soaked in Dakin's solution, or in 1 per cent. aqueous solution of mercurochrome. Carrel tubes, placed to reach all parts of the dressing, make possible its moistening without trauma in the period before a protective layer of granulations is formed. These dressings are changed every forty-eight hours, up to the sixth day, when daily dressings may be instituted.

At this time a course of staphylococcus vaccine may be used.

When the defect is granulating in a healthy manner, closure begins. If it is large, skin grafting may be resorted to. Many large defects, if there be plenty of loose surrounding skin available, will close with the aid of exercises, massage of the skin and, when possible, strapping with adhesive plaster.

In illustration, the reports of 3 recent cases are given:

Case I.—M. E. H., white female, aged fifty. Patient was admitted to hospital for a painful swelling of the left side of the lower lip. She stated that she had had two small furuncles in the past month. Two days previously she had noticed a tender pustule at the left extremity of the outer margin of the lower lip. It had increased in size. She had felt much below par with some nausea and malaise.

Local examination showed an area of skin of the left side of the lower lip, $\frac{3}{4}$ inches in diameter, which was brawny red, raised, and boggy looking. There were several small pustules toward its center. There was a tender, indurated region at the left angle of the jaw.

Her temperature was 101° F.; her pulse 100; urinalysis was negative for sugar and albumin.

She was put to bed; diet was ordered as desired. She took fluids well and these were forced. Hot flaxseed poultices were applied to the whole left lower jaw every hour.

On the second day after admission her temperature was 98.4° to 100° F.; her pulse 72 to 94. The area of induration around the carbuncle was much smaller. Several pustular openings had coalesced, giving free drainage. The glands at the angle of the jaw were palpable, but much less tender.

On the fourth day her temperature was 98.2° F., and her pulse 72 to 90. A small portion of the affected tissue had sloughed and the base was granulating. Tenderness at the angle of the jaw was much less.

On the sixth day the patient was discharged from hospital. The base of the carbuncle was granulating cleanly. The glands were no longer tender and the patient felt very much better. Her urine on discharge was again sugar free.

Boric acid ointment gauze dressings were used after she left the hospital, changed once a day. A course of staphylococcus vaccine was instituted which lasted two weeks. At the termination of this period the wound was firmly healed.

Case II.—A. R., a white male aged fifty-five, was admitted to hospital on account of painful swelling of the back of the

neck, of fever, and of prostration. Ten days previously a small red lump had appeared at the back of his neck. It had "come to a head," and been opened by his own physician. It had been poulticed, but had steadily increased in size to about 3 inches in diameter, with swelling and great pain. For a week he had felt unable to get out of bed; he had been feverish and weak. Poultices had been applied at irregular intervals.

On admission he was evidently very ill. His temperature was 100.8° F., and his pulse 90. His urine showed a slight trace of sugar. His white blood-cell count was 19,600. His blood-sugar was normal (0.12). Local examination showed an area of the back of the neck, $2\frac{1}{2}$ by 4 inches, which was raised and edematous. It was generally dusky red in color, with many pustules, some of them ruptured, scattered over its surface.

Operation was immediately undertaken and under gas-oxygen anesthesia the region was shaved and cleansed, and a cruciate incision carried out to the margins of the induration. The flaps were undercut, and the central sloughing part of the base was excised. A boric ointment gauze pack was then placed well in beneath the flaps.

Two days later the patient's temperature had become normal. Packing was removed and replaced. There was some induration at the extremity of the right lateral incision.

Three days after admission the patient's temperature again rose. He was extremely toxic. The process had extended toward the right ear beyond the end of the incision (see Fig. 61, Case II). Further incision was obviously necessary.

He was again anesthetized with gas and oxygen, and the lateral incision was prolonged well beyond the induration into fresh tissue. The flaps were further undercut, but it was obvious that, without another vertical incision, undercutting could not be carried beyond the line of induration into fresh tissue. A second vertical incision was made. A large quantity of slough was cut away from the base and the whole area repacked.

In the four days following, the patient's general condition improved greatly. Oral intake of fluids required supplementing by proctoclysis and, at the height of his toxemia, by intravenous

infusions of saline containing 10 per cent. glucose. His urinary output improved, and contained only slight traces of sugar.

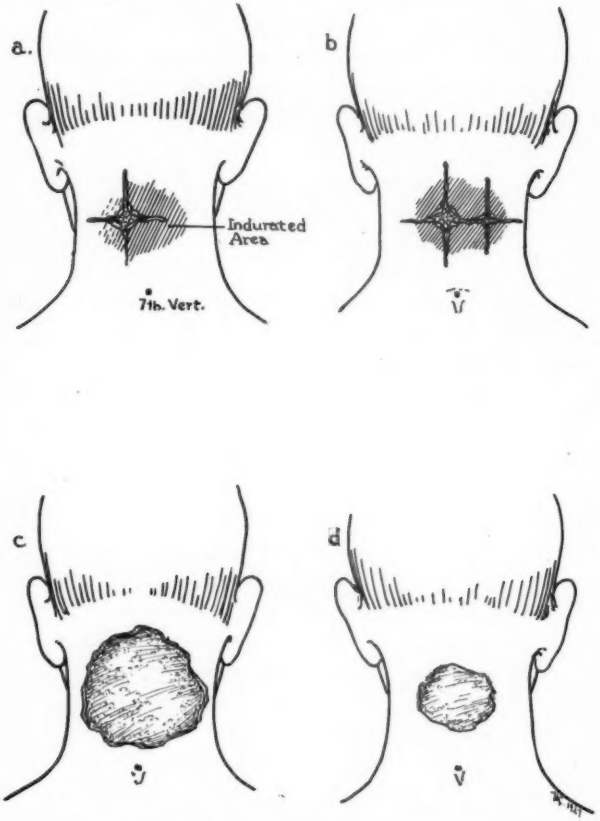


Fig. 61.—Case II (schematic drawing): In *a* we see a carbuncle of the neck two days after cruciate incision. This has been inadequate and induration has progressed to the right. In *b* the incision beyond the induration is demonstrated. In *c* we see the large granulating area after practically all of the flaps had sloughed. In *d* we see the relative change in size six weeks after operation.

On the fourth day the dressing was changed to one of gauze soaked in 1 per cent. aqueous solution of mercurochrome. Carrel

tubes were placed to all parts of the gauze so as to permit frequent moistening without trauma. (They were moistened three times a day.) Some of the sloughing edge of flaps was separated. The base had begun to granulate well.

Although the local lesion seemed to progress well, fever did not entirely subside, and the patient complained of some discomfort and tenderness in his scalp. On the seventh day, definite erysipelas with temperature of 104° F., and redness extending above the left ear and onto the face was evident. Frequent applications of a weak dilution of lead subacetate were made to the involved skin.

From the seventh to the fourteenth day, an irregular temperature continued, reaching 104° or 105° F. in the evenings. Blood-cultures taken on two occasions showed no growth. On the thirteenth day, 15 c.c. of erysipelas antitoxin (antistreptococcus hemolyticus serum) was given intravenously. This was followed by a drop in temperature which, after the eighteenth day, assumed a normal level. The skin inflammation rapidly subsided.

The lesion of the neck showed at this time a cleanly granulating base. The skin flaps had largely sloughed (see Fig. 61, *c* Case II). Mercurochrome dressings were being changed daily.

On the twenty-ninth day after final incision, the patient, who had been out of bed for one week, was doing well. Granulations appeared clean and healthy. Being of the opinion that skin grafting would shorten his convalescence, pin-point grafts, taken from the skin of the thigh, were implanted on the denuded area. This procedure was followed by a recurrence of the erysipelas, lasting about five days. None of the pin-point grafts took, all having become infected.

On the thirty-ninth day, daily lamp treatments were instituted. The skin of the neck was massaged toward the denuded area, which gradually decreased in size to an area $1\frac{1}{2}$ by 1 inch at the time of his discharge on the sixty-second day. This closure was for the most part by gradual approximation of the skin of the neck, with very little growth of new skin. He was sugar free on normal diet.

Two weeks after discharge the defect was entirely covered.

The progress of the lesion and the relative size of the defect can be seen in Figs. 61, 62.

Case III.—J. D., a white male aged seventy-two, was admitted to hospital on account of a sloughing indurated area on the back of the neck, and of fever and delirium.

Fig. 62.—Case II: Shows the scar three months after operation. Closure was almost entirely by replacement with skin brought over the lesion from the surrounding area by massage.

Five weeks previously he had had a "boil" on the back of his neck. It seemed to heal after simple local treatment. Four weeks previously it recurred, seeming to have several heads. It was curetted, under ether anesthesia, in his home, and, as areas sloughed, they were dissected away. The condition progressed to right and left, and up into his scalp.

During the week before admission he ran a temperature of 101° to 102° F., with profuse sweats, great weakness, and delirium.

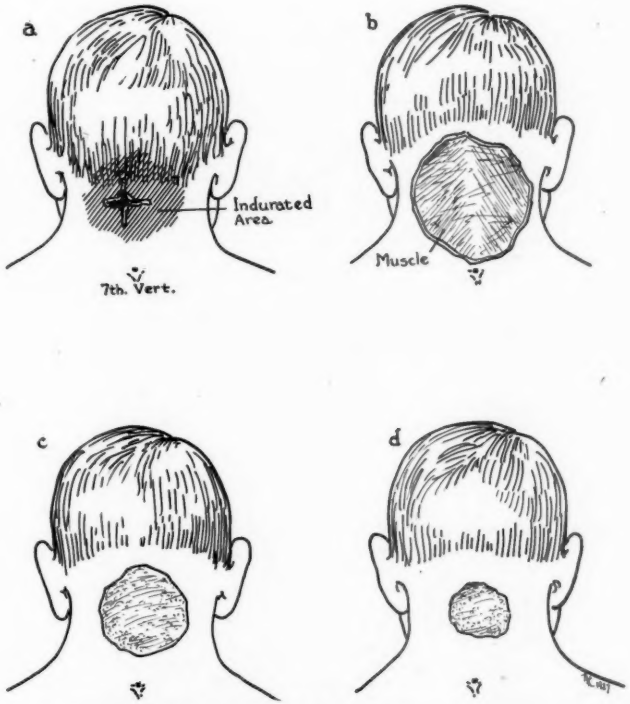


Fig. 63.—Case III (schematic drawing): *a* Shows the area of induration with the sloughing site of the previous incision in its center. *b* Shows the defect immediately after excision of all the indurated tissue and a margin of fresh tissue. *c* Shows this defect after three weeks. There has already been a marked degree of closure and the base is granulating cleanly. *d* Shows the relative size of the lesion five weeks after incision.

On arrival at the hospital his temperature was 101° F., and his pulse 84. He was semicomatose. His urine was negative for albumin and sugar.

Examination of his local condition showed a brawny induration of the back of the neck, from the mastoid region on the right

to a similar position on the left, and down to the level of the sixth cervical vertebra. A sloughing wound in its center marked the site of the previous curetting. Small pinhead-sized openings surrounded it.

The internist concurred in the opinion that surgical intervention was necessary, and that the patient, even considering his age, would prove a fair risk for gas-oxygen anesthesia.

Fig. 64.—Case III: Shows obliteration of the defect thirteen weeks after excision without the use of skin graft.

Under this anesthesia the hair of the back of the head was shaved, and the whole region cleansed with green soap and water, ether, and 3½ per cent. iodin. The gangrenous and indurated tissue was then completely excised down to the muscle, some of which, being involved, was also cut away. This large defect

was then packed with boric ointment gauze. Excision was chosen as the method of treatment in this case because it seemed necessary to free this patient immediately of the source of his toxicity in order to save his life.

His temperature became normal on the first day after operation, and remained below 99° F. After the fourth day he was rational and proceeded to make an excellent recovery. Mercurochrome dressings were used as in Case II, with the same scheme of management. The defect granulated with practically no further slough, and massage was commenced after the first week. He was given Alpine lamp treatments daily. He was encouraged to eat, and fluids were forced. A course of staphylococcus vaccine was given during his convalescence.

On his discharge, twenty-one days after his admission, the defect had decreased to approximately half its original size.

Two weeks later granulations were clean, and new skin was growing in from the edges which were gradually being approximated. There was plenty of loose skin from the sides of the neck.

Ten weeks after leaving the hospital the defect was completely covered. Figures 63, 64 show the extent and progress of the lesion.

MELANOTIC SARCOMA OF THE VAGINA. CASE REPORT

LAWRENCE W. SMITH AND JOHN V. LEECH

MRS. M. A. B., aged forty-five years, entered the hospital August 10, 1927.

Chief Complaint.—Swelling in the left groin of several months' duration.

Family history is unessential.

Past History.—General health has always been good. Average weight was 230 pounds.

Present Illness.—Began about a year ago when vaginal polyps were discovered. These were excised by the local doctor, but recurred some months later. Two months ago she noticed a lump in the left groin.

Physical Examination.—Showed a well-developed and obese individual, not in acute distress. The *skin* was warm and moist, and free from pigmentation except for small discrete brownish patches over the chest.

Head.—*Hair* is black, moderate in amount, and of medium texture. *Eyes* are negative. *Ears* and *nose* are negative. *Mouth:* Teeth are in fair condition.

Neck is normal—no thyroid enlargement.

Chest.—Breasts are negative. Lungs are clear and resonant. *Heart:* Slightly enlarged to percussion. Sound—of good quality and intensity, and regular. No murmur. Blood-pressure, 155/104.

Abdomen.—Soft and pendulous, shows old appendectomy scar. No fluid or masses made out.

Extremities.—Marked varicosities of both lower extremities.

Vaginal.—Many papillomata in vagina, brownish black in color and apparently malignant.

Glands.—Glands in left groin, firm and fixed. The right groin presents firm, thrombosed veins.

Clinical Diagnosis.—Melanotic sarcoma of vagina with metastases.

Operation.—August 11, 1927. Under gas-ether anesthesia the vulva was excised, including the labia majora and minora and clitoris. The patient was then placed in the horizontal position, and a complete dissection of the left groin was made. Here many glands were found which were apparently actively malignant. They were so extensive that, although the bulk was removed, it was deemed improbable that they were all removed, and further dissection in the right groin was not thought wise.

Postoperative Notes.—Patient made a good ether recovery. On the fifth day postoperatively she had an acute attack of epigastric pain and shortness of breath. This lasted a few minutes and was relieved by morphin. Pulse remained good throughout.

The sutures were removed on the eighth day. Catheter was removed the day before. Convalescence was very comfortable. The inguinal wound healed by first intention. The vulval stitches separated, leaving a granulating surface. No evidence of tumor was seen.

On the twelfth day, after getting into a chair, the patient felt suddenly weak. She did not lose consciousness; breathing became very shallow. She was placed in bed immediately; became very cyanotic; heart rapidly failed, and she died in about ten minutes, apparently of a pulmonary embolus.

Pathologic Report on Surgical Specimen.—Sections, microscopically, through the skin nodule show a tumor composed of cells of various sizes and shapes, ranging from polyhedral to nearly spindle in form, which are arranged either in solid masses or in alveolar fashion. There appears to be no direct continuity with the surface epithelium and, where the tumor is covered by squamous cells, these appear somewhat atrophic. There is considerable pigment found almost entirely within the tumor cells, although some granules are seen in the intercellular spaces of the stroma. An identical picture is presented by the lymph-nodes. This is an extremely difficult tumor to positively classify, but it is obviously one of great malignancy and I am inclined to feel that it should be considered as a melanotic sarcoma.

Diagnosis: Melanotic sarcoma with metastases.

The essential features of the autopsy protocol follow:

The heart was dilated and hypertrophied and weighed 340 gm.

The pulmonary vessels were opened *in situ* and multiple emboli were seen, the largest one being at the bifurcation of the artery. This measured 12 cm. in length. It extended into the right and left subdivisions of this vessel. A second embolus about half the size of the first was seen in the left lung. Microscopically, the smaller vessels were seen to be plugged, and there was an infarct of at least several days' duration.

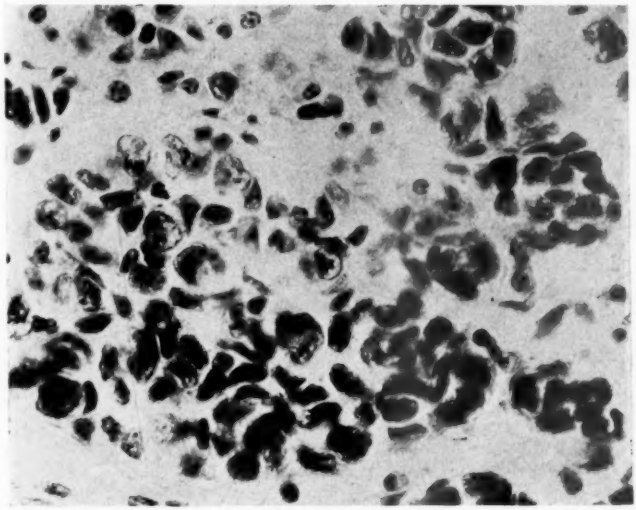


Fig. 65.—High-power photomicrograph—approximately ×6000. Shows nests of non-pigmented cells with suggestion of alveolar formation. Celloidin section—hematoxylin-eosin stain.

The liver weighed 2570 gm. and showed multiple small metastases. Microscopically they checked with the original tumor.

The spleen weighed 210 gm. and was the picture of congestion. There were no metastases.

Pancreas, kidneys, and adrenals were essentially negative.

Bladder showed a mild cystitis.

The gastro-intestinal tract was negative, except for a small metastatic tumor nodule in the cecum.

The mesenteric lymph-nodes also showed metastases.

The serosa of the uterus showed a small nodule of tumor cells.

The right groin was dissected at autopsy, but no involved lymph-nodes could be found.

Summary.—The immediate cause of death was a pulmonary embolus at the bifurcation of the pulmonary artery cut-

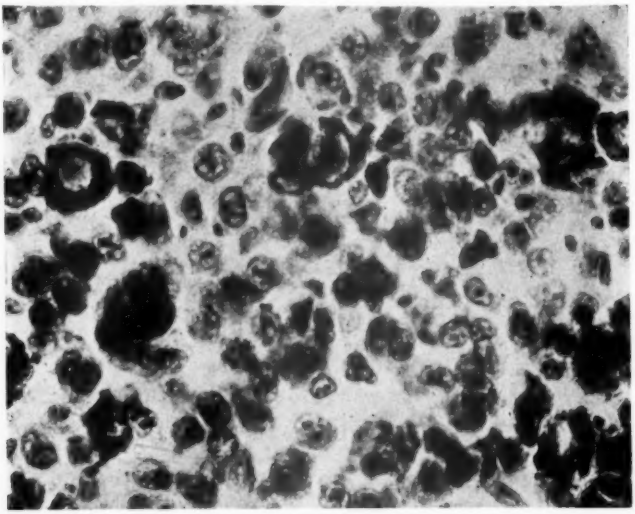


Fig. 66.—High-power photomicrograph—approximately ×600. Illustrates pigment granules in tumor cells and phagocytes.

ting off the circulation to the right and left lungs. The melanotic sarcoma removed at operation is believed to be primary in the vagina. The history of the case supports this opinion in that a similar tumor was removed by cautery more than a year ago in the same region. The growth removed at operation is believed to be a recurrence of the original tumor.

Discussion.—The chief point of interest in presenting this case is the unusual location of what is believed to be

the primary tumor. In a casual survey of the more recent literature regarding melanotic tumors, I have been unable to find any reference to a primary tumor of vaginal origin, although numerous instances of vulval origin are cited.

The group of pigmented tumors is, of course, still *sub-judice*. Ewing in his book on neoplastic disease states that the extant theories of the origin of melanomatas are as follows:

1. Exclusively from mesoblastic chromatophores.

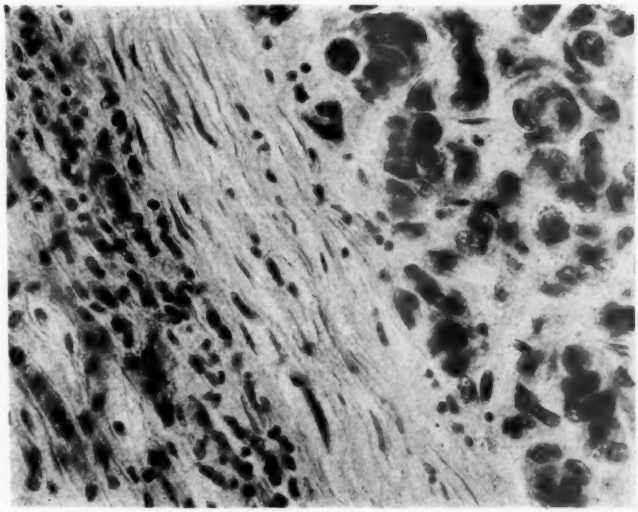


Fig. 67.—High-power photomicrograph—Leitz No. 2 ocular—4 mm. objective. ×600. Illustrated identical tumor tissue in liver metastases.

2. Exclusively from epithelial cells and epithelial chromatophores.

3. From epithelial nevus cells and mesoblastic chromatophores in the choroid and meninges.

4. From endothelial cells of blood- and lymph-vessels, or of nerve-trunks.

This particular tumor tends to be of the carcinoid type rather than of the sarcomatous type, as evidenced by the preponderance

of large polyhedral cells arranged more or less definitely in alveolar form. Relatively few of the cells show pigmentation, and there is but little free pigment in the intercellular spaces. There is but little tendency for the cells to become spindle-form.

The tumor, is furthermore, striking in that its metastases are for the most part regional and by way of the lymphatic circulation, although terminally more distant extension of the tumor cells to the liver and retroperitoneal tissues occur, presumably by the portal circulation. The case, however, does not show the wide-spread blood-stream distribution which one so frequently associates with the sarcomatous type of melanotic sarcoma.

There appears to be no reason for speculating in detail as to the histogenesis of these tumors. There is no evidence in this particular case to suggest that the tumor arose from the anal orifice or rectal ampulla, which are well recognized points of origin of certain of these melanotic tumors. Over 60 such cases have been described, and a polypoid form is not at all uncommon.

One other possible source of confusion lies in the fact that a nodule was found in the wall of the cecum. This part of the gastro-intestinal tract again is recognized as being a not infrequent site of primary melanotic sarcoma. In our case, however, there seems to be not the slightest shadow of doubt as to the metastatic nature of the cecal nodule found.

Masson's recent work on the intimate relationship of the melanoma to the nerve-cells is of fundamental significance. In connection with this case it offers speculative hypotheses of extraordinary scope. No such relationship, however, was found to exist by our technic. Whether this is the result of unfamiliarity with the method, or whether there is some inherent variation in different melanomata is still uncertain.

From the clinical standpoint, the interest of this case originally lay in the differential diagnosis between a simple polyp as distinguished from a malignant tumor. That it was assumed to be an innocent tumor originally is apparent. It was only by its subsequent course and recurrence that its identity was suspected clinically.

Summary.—A case of primary melanotic sarcoma of the vagina in a woman aged forty-five years is presented, with an abstract of the autopsy findings.

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STATUS THYMOLYMPHATICUS ASSOCIATED WITH HYPERTHYROIDISM

JOHN V. LEECH AND LAWRENCE W. SMITH

Definition.—Symmers[1] defined status lymphaticus as a constitutional hereditary anomaly characterized anatomically by certain external peculiarities of configuration, by hypoplasia of the cardiovascular apparatus, by hyperplasia of the thymus gland and of lymphoid tissue in other localities and, incidentally, by congenital structural defects in different viscera. Clinically the condition is not infrequently terminated by sudden death on apparently trivial provocation, most often in children, but occasionally in adults.

In a series of 4000 necropsies at the Bellevue Hospital, New York City, the condition was encountered 249 times or 6.2 per cent. One hundred and ninety-seven cases were males and 52 cases were females. The youngest subject was eight hours old and the oldest was thirty-eight years. The exact nature of the sudden and profound physiologic changes which take place to produce these unlooked for and unexpected sudden deaths is not understood, but in the past the following explanations have been offered—faulty metabolism, insufficient adrenalin, pressure upon the trachea from an enlarged thymus gland, over-function of the thymus, anaphylaxis, etc. The latter suggestion was supported by Symmers, who believed that death was brought about in one of two ways. First, by an anaphylactic reaction due to sensitization of the body by a specific nucleoprotein formed in the lymph-nodes as a result of necrosis of the germinal follicles. Then before the incubation period was completed, the body was again subjected to the action of the same protein which resulted in death. The second cause of death he believed to be due to the spontaneous rupture of a hypoplastic cerebral vessel, the deficiency of the wall being due to the muscular coat.

These unfortunate individuals are hypersusceptible to incidents in life which normal people recover from without diffi-

culty. In many instances death has occurred during anesthesia, following an operation, during marked degrees of emotional excitement, or physical exertion, or apparently mild infections. Thymic individuals present many of the tragedies of the operating room, and the frequent occurrence of these fatalities among children has resulted in routine thymic plates prior to operation on all children under fourteen years of age in many hospitals. The patients who are found to have thymic enlargement are given three or four treatments of the erythema dose of *x*-ray before operation. This has greatly reduced the number of deaths due to status thymolymphaticus.

That the hypo- or hyperplasia of the thymus gland is a function of a disorder of one or more of the glands of the endocrine system has been demonstrated by the recent and interesting experimental work of Marine, Manley, and Bauman.[2] The summary of their results on 373 experimental animals is given:

"Thyroidectomy hastens, while gonadectomy delays, but does not permanently prevent involution of the thymus.

"Suprarenalectomy alone not only delays involution of the thymus and lymphoid tissue, but may cause their regeneration. Thyroidectomy prevents this reaction even after combined suprarenalectomy and gonadectomy.

"Suprarenalectomy plus gonadectomy is a more powerful stimulus for thymus and lymphoid regeneration than either of these influences above.

"The combined effect of these two factors results in a certain lymphoid and thymus hyperplasia in rabbits which persists until regeneration of accessory interrenal tissue corrects the physiologic defects. The syndrome thus experimentally produced resembles status lymphaticus, and is believed to depend mainly on a partial loss of certain functions of the interrenal and sex glands rather than of chromaffin tissue.

"The normal and abnormal lymphoid and thymic hyperplasias of infancy and childhood are believed to be manifestation of a functional underdevelopment of the interrenal and sex-glands of varying intensity.

"The so-called lymphatic constitution which underlies or ac-

companies exophthalmic goiter, Addison's disease, and acromegaly also appears to be dependent on partial suppression of certain functions of the interrenal and sex glands."

These investigators find that thyroidectomy hastens involution of the thymus. These questions naturally follow: What is the relationship of the thymus and related lymphoid tissue to primary hyperthyroidism? Are the varying degrees of strumitis, so commonly observed in primary parenchymatous hyperplasia, a partial expression of generalized lymphoid hyperplasia?

We recently autopsied a patient, forty years of age, who died sixty hours following a right subtotal hemithyroidectomy. The only cause of death which could be found was status thymolymphaticus. There was a markedly enlarged and hyperplastic thymus together with generalized lymphoid hyperplasia. The important findings of the history, physical examination, and protocol are given.

Case Report.—Mrs. M. I. H., aged forty years and married, entered the hospital August 23, 1926.

Chief Complaint.—Dysphagia, pressure in the neck, tachycardia, and palpitation of three years' duration.

Family history is unessential.

Past History.—The only important events in the past history are ten normal pregnancies, severe lobar pneumonia three years ago, and oöphorectomy in 1925.

Present Illness.—According to the patient, illness began with a rapid heart, palpitation, and general weakness following her attack of pneumonia. The local physician examined her at that time and told her she had goiter. She noticed slight enlargement of her neck at this time. At times during the past three years she has had symptoms of pressure, choking spells, and dysphagia, all of which have been more severe since the oöphorectomy. For the past year she has complained of irritability, nervousness, and marked tremor. Exophthalmos for one year. She has lost 81 pounds in past three years, 50 pounds during the past year. When admitted to the hospital she weighed 106 pounds, and was in a severe state of thyrotoxicosis.

Physical Examination.—Showed a well developed, but greatly emaciated middle-aged woman, propped up in bed in apparent acute distress.

Head.—Hair dark, moderate in amount, and of normal texture. Eyes show marked bilateral exophthalmos. Nose, ears, and mouth are negative.

Neck.—Shows a palpably enlarged thyroid gland.

Chest.—Lungs, clear and resonant except at bases, which show a few fine, crepitant râles.

Heart.—Apex impulse seen and felt in fifth left interspace in midclavicular line. The sounds are poor in quality and intensity. The rate and rhythm are totally irregular. Rate at wrist, 115.

Abdomen.—Negative except for a midline suprapubic scar.

Extremities.—Negative except for slight edema.

Diagnosis.—Primary hyperthyroidism—severe, with established auricular fibrillation and congestive heart-failure.

Operation.—September 17, 1926. Right subtotal hemithyroidectomy.

Pathologic Report.—The specimen consists of a large lobe of thyroid gland measuring 8 x 6.5 x 3 cm. Grossly, it presents the picture of a primary gland, being pinkish in color, rather firm in consistency. The cut surface is smooth and homogeneous and shows no evidence of cystic degeneration, calcification, or formation of adenomata. Microscopically, the picture is that of a primary parenchymatous hyperplasia in a stage of late involution. The acini are uniformly small, containing a moderate amount of deeply staining colloid, and are lined with low cuboidal and flat epithelium. There is an increase in the connective-tissue element. Numerous small areas of round-cell infiltration are seen with the formation of lymph-follicles presenting active germinal centers.

Postoperative Notes.—September 18, 1926: No vomiting, pulse 100/130, general condition good. September 19th: Patient seen this morning; condition good, pulse 120/132. At 1.00 P. M., pulse was absolutely irregular and very rapid. Patient was restless and there was some cyanosis. At 5.00 P. M. the patient was unconscious, and at 8.30 P. M. died.

Abstract of Protocol.—Mrs. M. I. H., aged forty years, nineteen hours postmortem.

Thyroid.—The remainder of the thyroid is about the size of a hen's egg, and as firm in consistency. Microscopically, it checks with the surgical specimen previously described.

Thymus.—Weighs 45 gm., is firm and normal in color. Eight sections were studied, representing various parts of the gland. These all show a marked hyperplasia of the lymphoid elements, including the reticular and connective tissue. Hassal's corpuscles are normal in appearance. They appear relatively decreased as a result of the round-cell hyperplasia.

Spleen.—Is enlarged, weighing 225 gm. The capsule shows no thickening. It is rather firm in consistency. The color is purple and shows a little congestion. The follicles are enlarged, and there is some hyperplasia of the reticulo-endothelial system. The malpighian bodies are hyperplastic, and the pulp shows moderate congestion.

Adrenals.—Both are dissected out and they appear to be normal in size, color, shape, and consistency. However, the microscopic picture is that of a distinct hyperplasia and degeneration involving both cortex and medulla. The cortical cells are seen in various stages of degeneration, characterized by marked changes in cellular structure. Many of the cells show vacuolization of the cytoplasm, pyknosis of nuclei, and loss of normal staining reaction. The columns of cells are broken up and there is a marked increase in the interstitial connective tissue. Almost no normal cortical material is seen. The medulla is characterized by the same type of degeneration, but to a less degree. There is a small cortical pseudo-adenoma.

Lymph-glands.—The mesenteric and retroperitoneal glands manifest themselves by generalized and gross enlargement. Microscopically, they are very hyperplastic and congested. The lymphoid elements of the large intestine show enlargement, being easily palpable and miliary in type. Above the ileocecal valve the involvement of Peyer's patches is not so remarkable.

Ovaries.—Both are missing.

Note.—The pathology of the remainder of the organs is that

of a toxic myocarditis. The liver, pancreas, and kidneys are essentially normal.

Discussion.—In a somewhat hasty review of the literature no other reports of cases of primary hyperthyroidism and status thymolymphaticus were encountered. Miller[3] reports a case of a young man, aged nineteen, dying very suddenly while engaged in a tennis match. The postmortem showed death to be due to status thymolymphaticus, and there was also a "mild condition of colloid goiter."

This case is of interest because of the association of a perfectly definite, anatomic status thymolymphaticus in association with a marked primary hyperthyroidism. There are numerous conflicting points of evidence which tend to confirm in some instances, and to throw out in others, the relationship of these two conditions. Unfortunately, there is the conflicting factor of double oöphorectomy, which in animals, according to Marine's work, tends to produce some lymphoid hyperplasia in the thymus and, presumably, also in the thyroid. In this connection, however, it is interesting to note that the adrenals show the characteristic hypoplasia which also results in a disturbance in balance of the lymphoid tissue and the reticulo-endothelial system. Accordingly, it is hard to determine which of these factors is the more important in producing this anatomic disturbance of the lymphoid apparatus.

On the other hand, we have a recognizable clinical picture of very extreme thyrotoxicosis with the condition seen not infrequently of a clinical cardiac involvement. This is not borne out by histology of the myocardium to any great extent, although there is, perhaps, more myocardial degeneration than is ordinarily seen in the cases of thyrotoxicosis coming to autopsy.

Whether there is any actual relationship between the existence of the thymolymphaticus hyperplasia and the sudden death is highly problematic, especially as the patient had been through ten pregnancies and a severe case of pneumonia comparatively recently. This infection, however, antedated her oöphorectomy, and it is conceivable on the basis of the experimental evidence at hand that the entire change of the lymphoid

system occurred subsequently to the infection, in which case, obviously, it did not play any part at that time. At best, one can merely speculate as to the evaluation of the various phenomena involved, but it seems highly probable that some definite relationship does exist in view of our inadequate knowledge of the endocrine glands. It is of interest to record one of the oldest cases in the literature presenting the anatomic picture of status thymolymphaticus, regardless of the other factors.

The part which the thyroid plays in this case is of considerable interest. Whether the reduction in the colloid content of the gland involves in any way the balance of the other glands of internal secretion is not known. It is of interest to us in relation to the numerous cases of hyperthyroidism which we see in which a marked lymphoid hyperplasia of the thyroid occurs. The supposition that hyperthyroidism, either as a result of the increased thyroxin content of the gland or of its diminished colloid content which may exert an inhibitory action, may be intimately related to the lymphoid apparatus has been frequently brought out. We are distinctly of the opinion that the diffuse lymphoid infiltration of the hyperplastic thyroid gland is part of a picture of generalized lymphatism, and not one of inflammatory reaction. This hypothesis is, perhaps, supported by the findings in this particular case.

Summary.—A case of status thymolymphaticus, occurring in a woman forty years of age, in association with a severe primary hyperthyroidism, is presented. A theoretic discussion of the possible relationship of the various endocrine glands in producing this picture is also presented.

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TUBERCULOSIS OF THE THYROID GLAND

LAWRENCE W. SMITH AND JOHN V. LEECH

TUBERCULOSIS of the thyroid gland is still so infrequently noted that reports of additional cases are of real value in determining its incidence and significance. The histologic aspects of the disease have been covered adequately in a number of fairly recent publications. Apparently, the first recorded case was in 1862 and, since that time, scarcely 100 additional cases other than those associated with generalized miliary tuberculosis have appeared in the literature. Mosiman[5] in 1917 reported 9 cases, and reviewed the literature to that date. Since his paper 4 or 5 others of importance have appeared. Broders[1] in 1920 reported 7 cases from the Mayo Clinic, and commented on the significant relationship of the disease to hyperthyroidism. Nather[6] the following year cited an additional 5 cases and attempted a somewhat arbitrary classification of the types of the disease. Coller and Huggins[2] in 1926 reviewed the literature of the intervening ten years from the appearance of Mosiman's paper, and added 5 cases of their own from a series of 1200 thyroidectomies. Higgins[3] in the same year added 5 cases and discussed the condition from the etiologic standpoint.

Scattered single case reports have appeared also from time to time during this interval. These have all been included in Coller's and Huggins' paper with the exception of a short paper by Jean.[4] He recorded a case of a "cold" abscess in the thyroid of an army officer, forty-two years of age, without other evidence of tuberculosis. Before operation it was thought to be a cystic adenoma. It was incised and drained, and healed spontaneously without sinus formation. The organisms were readily demonstrated. He was able to find but 6 other comparable cases of actual tuberculous abscess formation.

During the past three years, in the course of routine examination of over 1500 thyroid glands removed surgically, as well as approximately 100 theoretically normal glands from miscellaneous autopsy cases, we have encountered, histologically, tuberculosis of the thyroid but three times, an incidence of less than $\frac{1}{4}$ per cent. (0.25 per cent.). In none of these cases had it been diagnosed preoperatively. In all 3 cases no clinical

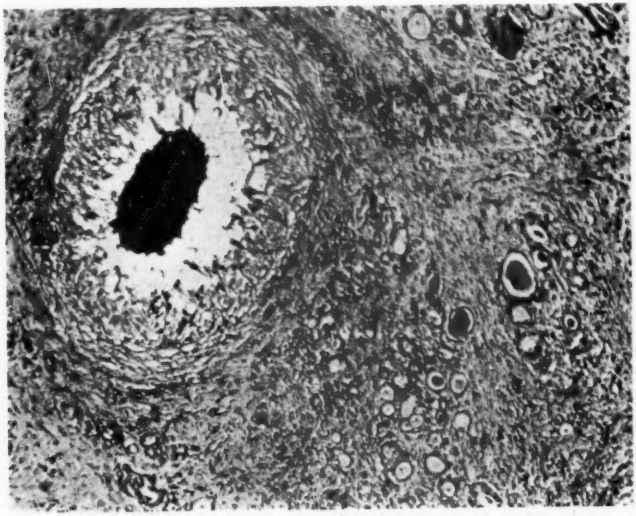

Fig. 68.—Low-power photomicrograph. Leitz 16 mm. objective. 2 × ocular, ×100. Illustrates the productive type of tuberculous exudate with an intra-acinar tubercle, showing some persistent colloid. Note diffuse interacinar fibrosis and lymphocytic infiltration.

evidence of active tuberculosis elsewhere was found, either at the original examination or on subsequent re-examination roentgenologically.

Case I.—(N. E. D. H., No. 41494.) Female, thirty-nine years of age, married.

Family and Past History.—Unessential—no history of tuberculosis.

Present Illness.—For four and a half months she has complained of a sense of pressure in the neck with alteration in temperature sensibility. She has shown an increased nervousness and irritability, with insomnia, and has developed a definite tremor. This has been accompanied by apathy, fatiguability and muscle weakness, and a loss in weight of about 10 pounds. This followed the birth of her fifth child. She has noticed a swelling in her neck for about two months.

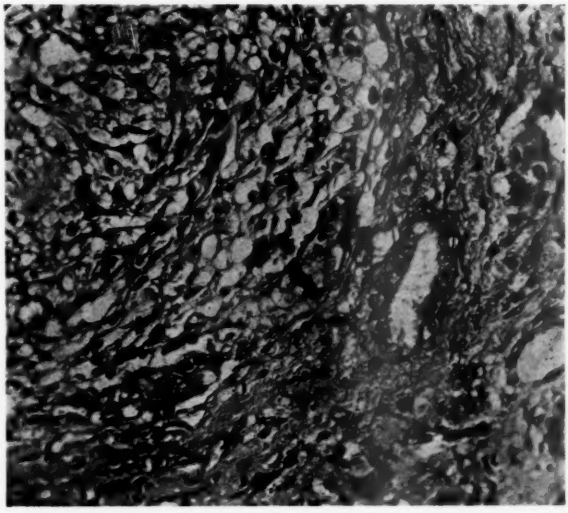

Fig. 69.—High-power photomicrograph. Leitz 4 mm. objective. 2 × ocular ×400 (approximate). Shows persistent thyroid acini with loss of colloid and marked proliferative type of interacinar miliary lesion.

Physical Examination.—Shows a diffuse increase in size of both lobes of the thyroid to about twice the normal size. The gland is firmly fixed and moderately tender. There is nothing to suggest hyperthyroidism. Preoperative diagnosis deferred, but the possibility of Riedel's struma or malignancy suggested.

Laboratory Examination.—*x*-Ray shows no deviation of the trachea.

Operative History.—Operation by Dr. Clute. Both lobes and

isthmus of the thyroid were found to be about twice normal size and of stony hardness. The underlying prethyroid muscles were infiltrated and tore easily. The surface of both lobes was excised with the greater part of the isthmus. Moderate amount of bleeding controlled by suture. One week later patient was discharged with a good operative recovery and convalescence.

Pathologic Report (DS-27-278).—Specimen consists of three portions of the thyroid gland. A description of one will serve

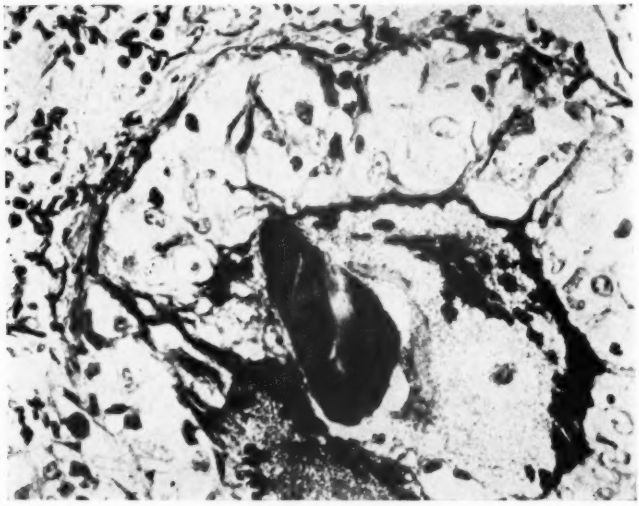

Fig. 70.—High-power, ×600 (approxiate). Illustrates an intra-acinar tubercle, with persistent colloid, beginning giant-cell production, and marked epithelioid hyperplasia.

for all. The largest measures 4 x 2 x 1 cm., and the next 3 x 2 x 0.5 cm., and the smallest is flat and measures 1 cm. in diameter. The anterior surface of the gland is covered by a capsule. The posterior surface is roughly granular, marking the point of dissection from the remaining portion of the gland. It is very firm in consistency, and pale pink in color, and on cross section it is finely granular and has the characteristic opalescent sheen.

There is some increase in the fibrotic tissue. There are no adenomatous nodules seen or felt.

Microscopic.—The sections present the typical picture of a diffuse, primary parenchymatous hyperplasia of the follicular type. There is very little evidence of involution as characterized by colloid retention. Several small miliary areas are noted which present a picture suggesting tuberculosis. The cells are radially arranged and are epithelioid in character. There is no caseation and no giant-cells are found. It represent a healing miliary tuberculosis.

Diagnosis.—Primary hyperthyroidism; miliary tuberculosis.

Case II.—(N. E. D. H., No. 38833.) Female, forty-six years of age, married.

Family and Past History.—Negative—no history of tuberculosis.

Present Illness.—Began with what was considered a bad cold and sore throat. Following this a few days after the onset, she noticed a tender lump in the thyroid region which has since subsided. She has lost 29 pounds since the onset. She complains now of hoarseness, weakness, and nervousness. She has been unable to do her housework for the past month.

Physical Examination.—Heart rate has increased, but there is no tremor or other evidence of hyperthyroidism. The gland is slightly enlarged, firm, and tender to manipulation on the left side.

Preoperative Diagnosis.—Thyroiditis, with the possibility of malignancy as a remote alternative.

Subsequent Notes.—One month after original examination she showed some toxicity with a pulse of 120 and a marked tremor. *x*-Ray examination shows no deviation of the trachea. The basal metabolic rate was normal.

Operative History.—Operation by Dr. Lahey. The gland was exposed and found to be a definite thyroiditis. The left lobe tended to be prolonged behind the clavicle. The isthmus was carefully separated from the trachea and excised. Trachea seemed to be flattened somewhat anteriorly. One week later the

patient's operative recovery was good aside from a local tenderness of the neck. Examination of lungs negative.

Pathologic Report (DS-27-439).—Specimen consists of the isthmus of the thyroid which has been submitted in two pieces of equal size. A description of one will answer for both. Specimen is surrounded by a connective-tissue capsule, and is brownish pink in color. It is soft in consistency, and on section it appears brownish white and glistening. No adenomatous nodules are felt and there is no evidence of necrosis or degeneration.

Microscopic.—The sections present a picture of chronic thyroiditis. This is characterized by marked fibrous tissue scarring. There is extensive infiltration of the stroma by lymphoid cells. The specimen was obviously adherent as considerable striated muscle is included. Several interacinar foci of tubercle formation are seen. These present the characteristic arrangement of the epithelioid cells with giant-cell formation. Sections stained by carbolfuchsin show beaded organisms presenting the morphology of tubercle bacilli.

Diagnosis.—Chronic tuberculous thyroiditis.

Case III.—(N. E. D. H., No. 38530.) Female, thirty-six years of age.

Family History.—There had been a family history of thyroid enlargement in one of her sisters.

Past History.—Negative—no history of tuberculosis.

Present Illness.—Patient was admitted because of marked loss of weight and increased nervousness of five months' duration since the birth of her fourth baby. This was accompanied by tachycardia, palpitation, and irritability. There has been slight exophthalmos of the left eye for the past two months. Thyroid enlargement was noted by her physician two weeks ago. She has lost 40 pounds in the past four months.

Physical Examination.—Slight exophthalmos on the left side. Quadriceps test, 0; heart rate, 108, regular; blood-pressure, 146; moderate palpitation; slight dyspnea. Preoperative diagnosis of primary hyperthyroidism with exophthalmos made.

The basal metabolic rate dropped from 58 to 23 in five weeks, on Lugol's solution.

Operative History.—A subtotal thyroidectomy was done on a definitely hyperplastic gland. One week later: Patient had a mild reaction following the operation, but her recovery subsequently was satisfactory.

Postoperative Laboratory Examination.—*x*-Ray of her chest shows no evidence of any active tuberculosis, but of healed apical and hilus lymph-node involvement.

Pathologic Report (DS-27-2421).—Specimen consists of three pieces of thyroid tissue which together weigh 60 gm. They are whitish pink in color, have a very firm consistency, and on section the cut surface is smooth and homogeneous. Practically no colloid material is seen. The tissue cuts with considerable resistance.

Microscopic.—Sections present the typical picture of tuberculosis. Numerous areas are found both inter- and intra-acinar in distribution which show characteristic epithelioid cell proliferation with giant-cell formation. About these areas is a zone of lymphocytic reaction. Special stains show acid-fast, beaded organisms presenting the morphology of tubercle bacilli.

Diagnosis.—Tuberculous thyroiditis.

Discussion.—Numerous attempts have been made to classify the type of lesions which may occur. It is, perhaps, trite to state that the most common form of thyroid tuberculosis is miliary, in association with generalized miliary tuberculosis. All three of our cases fall into this generic group. It is equally true that the cases of miliary tuberculosis have to be considered as of two types: (1) That associated with an acute form of the disease resulting in death from generalized tuberculosis within a comparatively few weeks. This is, then, only an incidental finding at autopsy and is of no clinical significance as far as the thyroid gland itself is concerned. (2) The more important group, that in which a hematogenous tuberculous infection occurs, but in which recovery of the patient or localization of the disease takes place. This is comparable then to the development of secondary tuberculosis as we see it elsewhere, particularly in the lymphoid tissues, as

in cervical adenitis. It is obvious that the degree of the reaction depends upon the virulence of the infecting organisms and the resistance of the individual, some lesions breaking down into "cold abscesses," others reacting by a proliferative process with diffuse fibrosis. In other words, tuberculosis of the thyroid must, of necessity, represent a blood-stream infection, except in the rare cases of direct extension from a tuberculous cervical lymphadenitis. It may be part of an acute generalized process and may be of no significance in respect to the thyroid, or it may result in active tuberculosis of a miliary, a diffuse proliferative, or a frankly caseous type.

Certain authors have classified the lesions on the basis of their their development, either as inter- or intra-acinar. Two of our cases have been entirely interacinar, as is the general rule. The third one, the more extensive of the three cases, has shown both types of lesion. Other authors have commented on the intracapillary origin and development of the tubercles.

The diagnosis is made positively only on the finding of tubercle bacilli in the lesions. It may be made presumptively on the finding of the usual epithelioid cellular reaction with the formation of characteristic microscopic tubercles, with or without giant-cell reaction or caseation. In one of our cases a single tubercle alone was found of unmistakable morphology, but in which no organisms could be demonstrated. This, we feel, represents a healing lesion associated with a mild, generalized infection. In the second case, organisms were definitely found although very few in number. Similarly, they could be demonstrated in the third case which was the most extensive of the three.

The experimental evidence indicating that the thyroid is particularly resistant to tuberculosis is not convincing, and yet on the basis of clinical evidence there seems to be little doubt but that such is the case. It seems to be a point worthy of further effort to explain.

The differential diagnosis is practically impossible preoperatively. There are two or three other conditions which are usually considered as more likely in the severe form of the disease,

but ordinarily the condition is overlooked entirely. Riedel's struma is probably the most frequently mistaken diagnosis. In this condition, the thyroid is apt to be uniformly enlarged, extremely firm, adherent to the surrounding tissue, and non-tender. In ordinary pyogenic thyroiditis, there is ordinarily a non-mistakable local tenderness, although the other factors may be comparable. In syphilis with gumma formation, the local examination is of little value. It should be suspected in the presence of a positive serologic reaction. We have encountered no cases in our entire series.

The other most frequent and difficult differential lesion, diagnostically, is malignancy. Our 3 cases were diagnosed preoperatively: Primary hyperthyroidism, question of Riedel's struma or malignancy, and chronic thyroiditis, respectively. Only one of our cases showed symptoms of hyperthyroidism. In a study of the literature the incidence is approximately 85 per cent. The possibility of the increased susceptibility of a hyperplastic gland as a result of the diminution in its colloid content has been one of the points stressed by many observers.

In conclusion, 3 cases of thyroid tuberculosis are reported occurring in routine material from over 1,500 surgically removed thyroid glands. Its chief interest lies in its comparative infrequency and the difficulty of preoperative differential diagnosis. It is usually not suspected and is confused with Riedel's struma or malignancy in the more severe forms, and is entirely overlooked in the milder forms, especially in hyperplastic glands in which the hyperthyroidism masks the underlying thyroiditis. The prognosis in these cases is usually excellent, as it apparently represents a localized lesion of the tubercle bacillus and its surgical removal results in complete recovery comparable to the removal of infected cervical glands or of a tuberculous kidney.

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THE USE OF EPHEDRIN IN SPINAL ANESTHESIA

LINCOLN F. SISE

SPINAL anesthesia is in many ways a most desirable anesthesia. Like other forms of regional anesthesia it places a minimum burden on the vital organs of the body. Unlike many of them, however, its technic is simple and easily mastered; with this one simple technic a large part of the body and a wide variety of operations are covered; its induction is practically painless; it contracts the intestines; and it gives profound muscular relaxation. It is therefore a very desirable anesthetic, especially for abdominal operations.

Its most serious drawback is the tremendous fall in blood-pressure, which it usually initiates when the anesthesia is high enough to extend materially into the abdominal region. Any one who has witnessed a few severe reactions of this sort—the vanishing blood-pressure, the slow, soft, or imperceptible pulse, the pallor, the clammy perspiration, the stupor, or air hunger—is very cautious about employing again this method of anesthesia.

Apart from this one drawback, the method is of such value that many have sought for some way of preventing or counteracting this fall in pressure. The best means available has appeared to be the use of adrenalin. Babcock[1] has clearly shown that it is almost an exact antidote. It is undoubtedly the best drug to use in an emergency, as its action is very rapid and powerful. Its action is, however, also very fleeting, so that it is necessary to give it frequently or continuously; and it acts but slightly unless given intravenously. For the numerous cases, therefore, who, while having a pronounced drop in pressure, are yet in no way an emergency, it leaves much to be desired.

The action of ephedrin is very similar to that of adrenalin, but is very much more prolonged. Its effects are produced by stimulation of the sympathetic nervous system, and are produced peripherally and not centrally. The rise in blood-pressure is due to vasoconstriction and cardiac stimulation. While adrenalin stimulates only the sympathetic endings in the heart, ephedrin stimulates also the stellate ganglions. With ephedrin, a greater proportion of the rise in blood-pressure appears to be due to cardiac stimulation than with adrenalin. While medicinal doses of ephedrin stimulate the heart, toxic doses depress it; and death is due to cardiac failure following clonic convulsions. Moderate doses sometimes cause extrasystoles and acute cardiac dilatation. If the blood-pressure is already low, the rise is less pronounced and the heart is more susceptible to the depressing action. Ephedrin dilates the pupils, and relaxes the bronchial and intestinal muscles. There is some evidence that it raises the blood-sugar. With repeated doses the effects are accumulative, and tolerance is not established. There is a wide margin of safety in dosage, as the lethal dose is 35 to 100 times the full physiologic dose. It may be given intravenously, subcutaneously, or by mouth. The effect is the same, but progressively slower and less intense by the last two methods. It is not decomposed by standing, exposure to light, or prolonged boiling. The usual dose for adults is 50 to 100 mg. of sulphate.[2, 3, 4, 5, 6]

The similarity to adrenalin in the action of ephedrin—the vasoconstriction, the marked cardiac stimulation with the pronounced rise in blood-pressure, and the fact that it acts peripherally and therefore is effective during the paresis of spinal anesthesia—at once suggests its use to counteract the fall of blood-pressure in this anesthesia. Rudolf and Graham[7] report its use in 26 cases. They injected it in doses of 50 to 100 mg. intravenously when the blood-pressure had apparently reached its lowest level. A rise in blood-pressure followed which they term extraordinary. The average rise was 68 mm., the least was 18 mm., and the greatest was 142 mm. The rise was maintained for an hour to an hour and a half.

Ockerblad and Dillon[8] report its use in 24 cases. They in-

jected it in 100 mg. doses subcutaneously when the blood-pressure had fallen 10 per cent. They give charts of individual cases, showing much higher pressures with it than without it.

We have used this drug with favorable results in our most recent cases. Those of these cases—16 in number—in which the anesthesia reached to the epigastrium or higher, and in which a considerable fall in blood-pressure was therefore to be expected, are here reported. In each case 50 mg. of ephedrin sulphate were injected subcutaneously. In the first 5 cases it was given

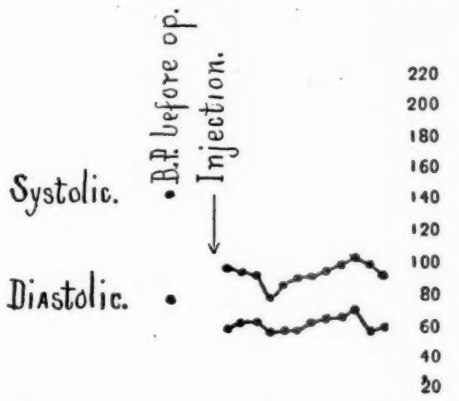

Fig. 71.—Eleven cases not receiving ephedrin. Average systolic during operation, 90; a decline of 36 per cent. from that before anesthesia. Age sixty-one years, weight 160 pounds; six males and five females. Novocain 107 mg.

only after the pressures had fallen considerably, and the need for it was evident. In the last 11 it was given as soon as a successful tap of the spinal canal had been made. Going back over our records, the first 11 cases that showed a similar height of anesthesia, but that had not received ephedrin, were selected for comparison. Blood-pressure readings during operation in these three groups of cases are shown in Figs. 71–73. Each number given—both the data, as to age, weight, etc., and each blood-pressure observation—is an average of all the available cases in the group.

It will be noted that those cases that received the drug only *after* a marked fall in pressures had taken place showed no evident benefit from the drug, while those who received it *before* there was any fall showed decided benefit, and ran a very satisfactory course. This is in accord with experimental findings that the rise in pressure following ephedrin is less, if the pressure is already low at the time of giving it. The improvement in our last 11 cases over the 11 control cases is all the more satisfactory when it is considered that, although they were a little older and

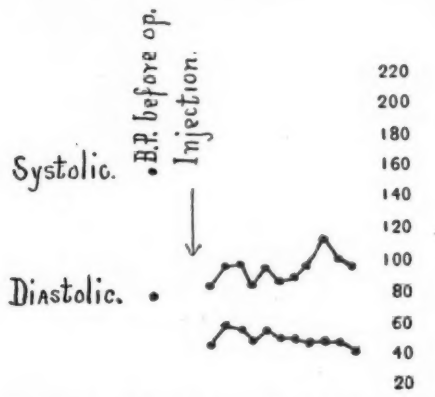

Fig. 72.—Five cases receiving ephedrin *after* the spinal injection. Average systolic during operation, 91; a decline of 42 per cent. from that before anesthesia. Age sixty-one years, weight 161 pounds; one male and four females. Novocain 116 mg.

weighed a little less than the controls, they received a considerably larger dose of novocain. The difference between our results in our first group of 5 cases and those of other observers, mentioned above, is due probably to the larger doses which they used and to the fact that the drug was gotten more surely into the circulation by them, because Ockerblad and Dillon[8] injected after a drop of but 10 per cent. in pressure, while Rudolf and Graham[7] injected intravenously. The poor results in our first 5 cases are probably due largely to the lack of absorption caused by the already lowered pressure.

From the evidence here presented we believe that we have in ephedrin an extremely valuable, in fact, almost an ideal drug for the prevention and even for the reversal of the drop in blood-pressure commonly seen in spinal anesthesia reaching above the groins. In the cases with moderate height and length of anesthesia, 50 mg. of the sulphate should be given subcutaneously before the anesthesia becomes effective. We have not used larger doses, because we have felt that a slight drop in pressure with the slight slowing of the pulse which usually accompanies it was not

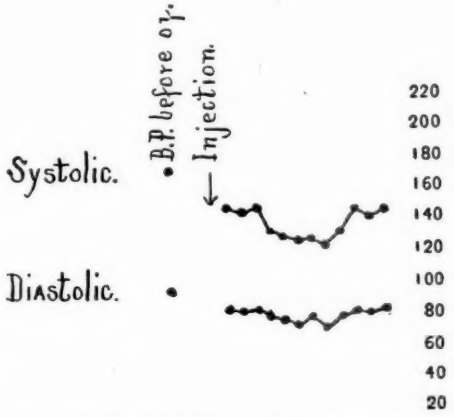

Fig. 73.—Eleven cases receiving ephedrin *before* the spinal injection. Average systolic during operation, 130; a decline of 22 per cent. from that before anesthesia. Aged sixty-four, weight 153 pounds; six males and five females. Novocain 121 mg.

at all detrimental to the patient. A marked drop in pressure is, however, to be avoided, so that for a high anesthesia with a heavy dose of the anesthetic agent, 100 mg. would probably be better. If, in spite of the prophylactic dose, a marked fall in pressure takes place, an intravenous injection of 50 mg. may be given with the expectation of producing a well-marked rise in pressure. Should still further stimulation be necessary, however, it would probably not be well to continue with this drug, as, with repeated doses, a point is reached where cardiac stimulation ceases and

depression begins. Instead, resort should be had to adrenalin. These two drugs work well together, and in fact synergistic action may be expected.[5]

Summary and Conclusions.—(1) The action of ephedrin is very similar to that of adrenalin. It stimulates the sympathetic nervous system and raises blood-pressure by vasoconstriction and cardiac stimulation. A larger proportion of the rise is due to cardiac stimulation than is the case with adrenalin.

(2) Fifty cases from the literature and 16 cases of our own are reported in which the use of ephedrin in spinal anesthesia showed very favorable results.

(3) As a prophylactic, 50 to 100 mg. of the sulphate may be given subcutaneously before the anesthesia becomes effective. As a remedy, 50 mg. additional may be given intravenously; but its use should not be continued beyond this point.

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REGULATION OF CARBON DIOXID DURING INHALATION ANESTHESIA

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REGULATION of the amount of carbon dioxid in the patient's body is a very important procedure during inhalation anesthesia. It is probably done, consciously or unconsciously, by every anesthetist of experience. More and more we have been doing it with direct, conscious intent. At first we supplied carbon dioxid from the patient's expirations by means of rebreathing. Somewhat over two years ago we started supplying it directly from tanks, and have found this method so much more convenient and effective that it has become an established and routine procedure.

Of the many actions of carbon dioxid, its action on the respiratory center is the one which chiefly concerns the anesthetist. The respiratory center is very sensitive to changes in its reaction. Change in its reaction may be due to changes in the metabolism of the center itself,[1] or to changes in the reaction of the bloodstream. While the center is stimulated by an increase of acidity due to any sort of acid, it appears that it is especially sensitive to an increase of acidity due to carbon dioxid[2]; and that carbon dioxid may, therefore, be regarded as a special respiratory stimulant.

The normal content of the alveolar air under resting conditions is about 5.6 per cent. carbon dioxid. If this is increased by 0.2 per cent., respiration is doubled, and if it is decreased a like amount by voluntary breathing, respiration ceases for a time. The extraordinary sensitiveness of the respiratory center to carbon dioxid is seen in the fact that these changes correspond to but two parts by weight of carbon dioxid in one million parts of arterial blood.[3]

When the carbon dioxid is reduced below normal, the condition known as acapnia results. This word was first used by Mosso and is derived from the Greek word καπνός, meaning smoke. This condition is characterized by shallow respiration, or even apnea, and by diminished vascular and intestinal tonus.

If the carbon dioxid content of the body is raised above normal, the condition of hypercapnia results. The most noticeable effect of this condition is stimulation of respiration. In most cases the first increases in carbon dioxid cause an increase in the depth rather than in the rate of respiration. The proportion which the dead space of the respiratory tract bears to the total volume of each respiration is thus decreased, and the total ventilation is much increased. With a few individuals the rate rather than the depth of respiration is increased. When the increase of carbon dioxid exceeds about 5 per cent., the limit of increased depth of respiration has usually been reached. At about this point, therefore, there is a gradual change in respiration. Increased rate becomes added to increased depth, so that the total ventilation is still further increased. The apex of stimulation is reached at about 10 per cent. to 15 per cent. Beyond this point, carbon dioxid becomes a respiratory depressant. High concentrations cause death by paralysis of respiration and asphyxia.

Intestinal peristalsis is increased and the mental condition is dulled. So marked is this latter effect that carbon dioxid has, in fact, been used very successfully as a preliminary brief anesthetic in the induction of ether anesthesia.

As previously stated, the sensitiveness of the respiratory center to any increase in carbon dioxid is very great. Thus the body is guarded very efficiently against hypercapnia. As soon as there is any increase in carbon dioxid, increased respiration throws off most of the increase. This very efficient protection against hypercapnia would indicate the possibility that there might be some danger in any great increase of carbon dioxid. Henderson,[4] quoting Bellazzi and Laqueur, states that hypercapnia accelerates autolysis, and Cannon[5] states that cellular oxidation is interfered with.

The effect of carbon dioxid on respiration is sometimes complicated by changes in the oxygen supply. While an increase of oxygen has little if any effect on respiration, a diminution below about 13 per cent. in the inspired oxygen has a stimulating effect until anoxemia becomes extreme, when respiration is depressed. The changes of respiration produced by variations in the oxygen supply may be quite pronounced and striking and, if the changes in supply are sudden, regulation of respiration may apparently be transferred from carbon dioxid to oxygen. If, for instance, anoxemia is produced during nitrous oxid or ethylene anesthesia, respiration will be at first stimulated, and then, as anoxemia becomes extreme, it will be depressed. If during this anoxemia an abundant supply of oxygen is suddenly admitted, at least shallow respiration and usually apnea will result; and frequently this apnea will continue until anoxemia again makes itself felt.

The importance of controlling respiration during anesthesia is seen when we come to consider the influence of respiration on the absorption and elimination of inhalation anesthetics. This influence, while important with all these anesthetics, is probably most important with ether. The absorption and elimination of ether is so much slower than it is with gas anesthetics that anything which will quicken these two processes is quite desirable.

In the induction of ether anesthesia, the ether is subjected to two processes of transportation and exchange. In the first process it is transported by the respiration from the outside air into the lungs, and is there exchanged from the air of the lungs into the blood circulating through the lungs. In the second process it is transported by the blood-stream from the lungs to the various tissues of the body, and is there exchanged from the blood to the tissues. It is the first process only which concerns us here.

To induce ether anesthesia it is necessary to bring the tissues of the central nervous system up to a certain tension of ether. As these tissues have a certain bulk, it is therefore necessary to bring to them a certain bulk of ether. Our problem, therefore, resolves itself into the bulk or total amount of ether introduced

into the body in a given time, and is concerned only incidentally with the concentration of ether in the inspired air.

It is evident that the amount of ether brought to the lungs in a given time depends on two factors: the concentration of ether in the inspired air and the total volume of the respiration. The amount of ether brought can be doubled just as surely by doubling the volume of respiration as it can be by doubling the concentration of ether—and much more advantageously. Ether is an irritant anesthetic. Too great concentration during induction produces a flow of mucus and saliva, a questionable effect on the bronchi and lungs, and protective reflexes such as swallowing, holding the breath, or spasm of the glottis.

All these ill effects can be avoided if, instead of increasing the concentration of ether, the volume of respiration is increased. In this way carbon dioxid is of great assistance during ether induction, as it lessens markedly the time necessary to produce any given stage of anesthesia, while at the same time it avoids the ill effects of high ether concentrations.

Anesthetists have for a long time increased the carbon dioxid during induction by means of rebreathing. It seems quite probable that a very definite proportion of the speed attained in induction of gas-ether sequence is due to rebreathing during the induction rather than to the gas used. Rebreathing, while quite effective, has its limitations. There are certain types of patients with whom a very large amount of rebreathing is necessary in order to stimulate respiration to the desired point. As a comparatively large amount of the anesthetic is absorbed during induction, it is necessary at this stage to use a large flow. As a large flow is not compatible with a large amount of rebreathing, we are confronted by the "horns of a dilemma." If we use a large flow of anesthetic we cannot get enough rebreathing to stimulate respiration to the optimal point. If, on the other hand, we use enough rebreathing to obtain the desired respiration, we cannot admit enough anesthetic to keep pace with absorption. This dilemma is solved for ether in those types of apparatus where the ether is volatilized by the breathing of the patient directly in the rebreathing circuit. Thus, as the anesthetic does not have to

be admitted from the outside, sufficient rebreathing can be maintained, especially if oxygen rather than air is used to supply the oxygen needs of the patient. Where the anesthetic cannot be volatilized directly in the rebreathing circuit, as is the case when using gas or when using most forms of gas apparatus for ether indication, the dilemma is solved by adding carbon dioxid to the mixture of gases. It is easy then to have enough carbon dioxid to stimulate respiration to its optimum point, even though a flow of anesthetic is used large enough to keep pace with absorption.

This stimulation of respiration during induction is most useful with ether. With nitrous oxid it is hardly ever desirable to use more than ordinary rebreathing. With ethylene the use of carbon dioxid is occasionally desirable. Under ethylene the volume of respiration is decidedly less than it is under nitrous oxid. In certain patients, probably those susceptible to the preliminary hypodermic of morphin, respiration during induction becomes greatly depressed and may even terminate in apnea, even though they are still too light to initiate surgical procedures. This condition is quickly and easily solved by the exhibition of carbon dioxid.

While stimulation of respiration is most frequently of benefit during induction, yet during maintenance of ether anesthesia there are times when it is a great help. These are the times when the surgical procedure necessitates an abrupt deepening of the anesthesia, or when the patient has gotten too light and the reflexes come into play, or he appears about to vomit. At these times the problem and its solution are similar to those during induction. With a nauseated patient, the strong urge to breathe, initiated by carbon dioxid, appears to inhibit, temporarily at least, the vomiting reflex. It is, however, necessary to get carbon dioxid actually into the patient sufficiently early for, if gagging has once started, respiration is so interfered with as to make the procedure difficult or impossible.

In using carbon dioxid for the abrupt deepening of anesthesia during ether maintenance, a word of caution is necessary. During induction there is no store of ether already in the body. Comparatively large amounts of ether may, therefore, be thrown

rapidly into the blood-stream, because they are rapidly absorbed by the tissues of the body. During maintenance, however, there is a very different condition. Here there is a considerable store of ether already in the body. If a large amount is rapidly added to this, the patient may be plunged into extreme depth before he can be stopped. Thus it is not well at this time to continue vigorous respirations with any considerable concentration of ether for more than a short time, when either the concentration, the respiration, or both should be cut down.

We have hardly ever felt it necessary to add carbon dioxid to the anesthetic continuously for any considerable period during maintenance, because, by rebreathing, a sufficient amount can be retained from the patient's respirations. Here we are not confronted with the dilemma experienced during induction, because, as the patient is already well saturated with the anesthetic, a large flow is not necessary, and any amount of rebreathing may thus be used.

During recovery from an inhalation anesthesia, the processes of transportation and exchange of the anesthetic, as outlined for induction, are just reversed. Increased respiration thus speeds up recovery just as it speeded up induction. It is not necessary thus to speed up recovery from the gas anesthetics, because they are thrown off so rapidly during ordinary respiration. But recovery from ether is usually slow, and often accompanied by periods of respiratory depression. If it is desired, elimination may be greatly speeded up, and these periods of depression avoided by the use of carbon dioxid. Its advantages have been shown by J. C. White[6] and others.[7, 8, 9, 10] They note a more rapid recovery with less depression, nausea and vomiting, gas pains, and possibly lung complications.

Summary and Conclusions.—Carbon dioxid is the physiologic stimulant to respiration, and its use is of great help in regulating respiration during anesthesia. Its most effective field is in ether induction, but it is also valuable at any time during inhalation anesthesia when stimulation of respiration is needed. By its use we gain control over the patient which we cannot get in any other way.

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AN AID TO POSITION IN THYROID SURGERY

LINCOLN F. SISE

SURGICAL procedures are greatly facilitated by proper position and exposure of the operative field. Other things being equal, the ease of any operation is proportionate to the visibility and accessibility of the part to be operated upon.

In thyroid surgery various devices have been used to bring the thyroid gland into prominence.

1. Extending the head by dropping it backward has not in our hands proved at all satisfactory. While the upper part of the gland may be fairly well exposed, the lower part, especially in deep-chested and muscular individuals, is not readily brought out from among the muscles.

2. A sand-bag, placed under the spine at about the level of the sternal notch or a little lower, frequently gives very good exposure. It is, however, awkward to place and remove and is not adjustable to height. It therefore cannot give the best possible exposure in each case because of variations in different individuals.

3. The best exposure in each case we find can be obtained by means of a bridge which is placed like the sand-bag, and which can be raised and lowered, and adjusted to any desired height.

We have used for some years with considerable satisfaction the Crile goiter bridge. While this gives very good exposure, there are a few points about its operation which lack convenience.

1. It is raised and lowered by a crank, which is inserted at the side of the table. This crank is a little difficult for the anesthetist to reach, and the raising of the bridge therefore usually requires the services of an extra person.

2. When raised to the desired height it is kept from falling by means of a ratchet. In order to disengage the ratchet when

lowering the bridge, the latter must be raised slightly. With light patients this may be done without the aid of the crank, but in that case the bridge may either stick and go down with difficulty or it may drop with a sudden thump. With heavy patients it is necessary to insert the crank again.

3. The crank, being detachable from the table, is sometimes not on hand just when it is wanted.

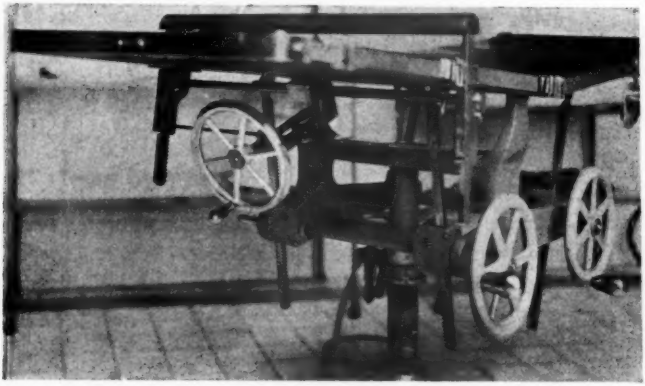

Fig. 74.—General arrangement of bridge, showing control-wheel and gear-box beneath center of table.

To obviate these difficulties we have modified the Crile bridge as follows: The axle, which in the Crile arrangement is actuated by the crank, is in our modification actuated through a worm gear by means of a wheel under the center of the table. This wheel is easily reached by the anesthetist at the head of the table; the motion of the bridge is smooth and easily controlled; and it will stay fixed at whatever height it is placed. We find this the most satisfactory apparatus which we have used for exposing the thyroid field.